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Impact Assessment of the Endeavour Fund

Final Report

24 April 2026



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Report to:

Ministry of Business, Innovation and Employment

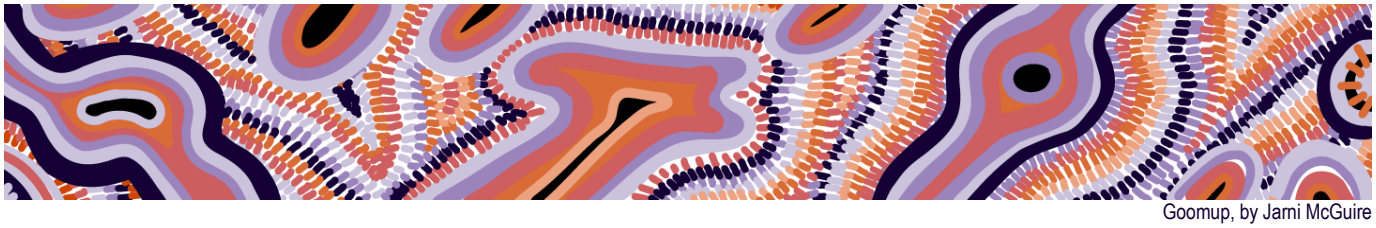
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Goomup, by Jarni McGuire

Contents

Glossary i

Summary Report iii

Executive Summary iv

Main Report 1

1 Introduction 2

1.1 The Endeavour Fund 2
1.2 Scope of this impact assessment 5
1.3 Report structure 5

2 Methodology 6

2.1 Impact assessment approach 7
2.2 Interpreting the outcomes of the impact assessment 12

Part 1: Impact report 14

3 Economic impacts 15

3.1 Measured economic impacts 15
3.2 Other economic impacts 22
3.3 Examples of excellent research that deliver direct quantifiable impacts 25

4 Broader impacts 26

4.1 Contribution to research 26
4.2 Social impacts 35
4.3 Environmental impact 39
4.4 Cultural impacts 42
4.5 Alignment with government priorities 46

5 International comparisons 51

5.1 Comparison funds 51
5.2 Design and key features 54
5.3 Outcomes and impacts from funding 58
5.4 Lessons for Endeavour 64

6 Concluding remarks 65

6.1 The Fund's focus 65
6.2 Evidence of tangible impact 65
6.3 Endeavour's full impact is not yet visible 66

Part 2: Case Studies 68

Contents

7 Case Study 1: Augmented Nutrition 69

7.1 Case study framework 69
7.2 Background 70
7.3 Inputs 70
7.4 Activities 71
7.5 Outputs 72
7.6 Outcomes 73
7.7 Impacts 74
7.8 Potential future impacts 77

8 Case Study 2: Fungal Factories 79

8.1 Case study framework 79
8.2 Background 80
8.3 Inputs 82
8.4 Activities 83
8.5 Outputs 83
8.6 Outcomes 84
8.7 Impacts 85
8.8 Potential future impacts 90

9 Case Study 3: Future Bees 92

9.1 Case Study Framework 92
9.2 Background 93
9.3 Inputs 94
9.4 Activities 95
9.5 Outputs 95
9.6 Outcomes 97
9.7 Impacts 97
9.8 Potential future impacts 104

10 Case Study 4: Remyelination in MS 106

10.1 Case study framework 106
10.2 Background 107
10.3 Inputs 108
10.4 Activities 109
10.5 Outputs 109
10.6 Outcomes 110
10.7 Impacts 111

Appendices 120

A Detailed modelling approach A-1

A.1 Why use a CGE model to evaluate economic impacts? A-1
A.2 Scenarios modelled A-2
A.3 Model inputs A-2
A.4 Labour market sensitivity A-17

Contents

B Literature review of rate of return on research B-1

B.1 Glossary of key terms B-1
B.2 Literature review methodology B-2
B.3 The role of R&D in an economy B-3
B.4 The economic impact of R&D B-4
B.5 Reference list B-15

C The *Tasman Global* model C-1

C.1 A dynamic model C-1
C.2 The database C-1
C.3 Model structure C-3
C.4 Population growth and labour supply C-6

D Additional Survey Results D-1

D.1 Attribution D-1
D.2 Impact by field of research D-3

Glossary

Abbreviations	Definitions
ACC	Accident Compensation Corporation
ANZSIC	Australian and New Zealand Standard Industrial Classification
ARC	Australian Research Council
BCR	Benefit-Cost Ratio
CAGR	Compound Annual Growth Rate
CBA	Cost Benefit Analysis
CGE	Computable General Equilibrium
CRI	Crown Research Institutes
DIA	Department of Internal Affairs
DPMC	Department of the Prime Minister and Cabinet
DSIT	Department for Science, Innovation and Technology
ETF	Enteral Tube Feeding
EU	European Union
FDA	Food and Drug Administration
FoR	Fields of Research
FTE	Full Time Equivalent
GBS	Genotyping by Sequencing
GDP	Gross Domestic Product
GMO	Genetically Modified Organism
HRC	Health Research Council
ICU	Intensive Care Unit
imi	a tribe within Moriori society.
IP	Intellectual Property
IRANZ	Independent Research Association of New Zealand
IRC	Irish Research Council
iwi	a large group of people descended from a common ancestor and associated with a distinct territory within Māori society
kaumātua	the elderly, or a person of status within the whānau.
kaupapa Māori	a philosophical doctrine, incorporating the knowledge, skills, attitudes and values of Māori society.
Mahinga kai	species, natural habitats, materials and practices used for harvesting food, and places where food or resources are, or were, gathered.
mātauranga	knowledge, wisdom, understanding or skill. Sometimes used in plural
MBIE	Ministry of Business, Innovation and Employment
MfE	Ministry for Environment
MIDAS	Modular Idempotent DNA Assembly System
Moriori	Indigenous people of Rēkohu, the Chatham Islands, who likely arrived from Eastern Polynesia around 1500.
MSc	Master of Science
MWLR	Manaaki Whenua – Landcare Research
NCGP	National Competitive Grants Program

Abbreviations	Definitions
NDA	Nodulisporic Acid
NEMA	National Emergency Management Agency
NGO	Non-Government Organisation
NPS-FM	National Policy Statement for Freshwater Management
NPV	Net Present Valuations
NZHWR	New Zealand Health, Work and Retirement
NZIC	New Zealand Institute of Chemistry
OSPRI	Operational Solutions for Primary Industry
PRO	Public Research Organisation
PSREs	Public Sector Research Establishments
rNPV	Risk-adjusted Net Present Value
ROR	Rate of return
SEO	Socio-Economic Objective
SFI	Science Foundation Ireland
SPF	Strategic Priorities Fund
SOM	Self-Organising Maps
Te Mana o te Wai	A concept that refers to the fundamental importance of water and recognizes that protecting the health of freshwater protects the health and well-being of the wider environment. Te Mana o te Wai is about restoring and preserving the balance between the water, the wider environment, and the community.
TRLs	Technology Readiness Levels
UKRI	United Kingdom Research and Innovation
whakapapa	Genealogy, genealogical table, lineage, descent. Reciting whakapapa is an important skill and reflected the importance of genealogies in Māori society in terms of leadership, land and fishing rights, kinship and status.
whānau	extended family, family group, or a familiar term of address to several people.

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Summary Report

Executive Summary

The Endeavour Fund

The Endeavour Fund (the Fund) is New Zealand's largest contestable research fund. The Fund is administered by the Ministry of Business, Innovation and Employment (MBIE). Since the Fund's establishment in 2016, it has delivered $2.31 billion in funding to New Zealand's research and innovation system, approximately $230 million per year. Over its 10 years of operation, the Fund has evolved in its design and processes, but its central goals of supporting excellent research and maximising the benefits for New Zealand have remained consistent.

It supports researchers to address major challenges and deliver transformative outcomes with the potential to positively impact New Zealand's economy, environment, and society, unlock the potential of Māori knowledge, people and resources, and enhance New Zealand's focus on excellent research and impact in areas of future value, growth or critical need for New Zealand.

The Fund invests in research and innovation through 2 main streams, Research Programmes and Smart Ideas:

- Research Programmes support large-scale, multi-year projects (typically 3–5 years) that pursue ambitious, high-quality research addressing areas of national value or strategic importance. These programmes receive an average of $10 million over 5 years to deliver transformational outcomes, foster collaboration, and build capability across sectors.
- Smart Ideas fund smaller, high-risk, high-reward projects (usually 2–3 years) that explore bold and innovative concepts with potential to benefit New Zealand's economy, environment, or society. With up to $1 million in funding, they aim to test and validate new approaches that could lead to future breakthroughs or larger research initiatives.

This impact assessment

In late 2025, ACIL Allen was engaged by MBIE to undertake an independent impact assessment of the Fund. The purpose of the assessment was to provide insight into the outcomes and impact resulting from research funded through the Fund.

The core objectives of the assessment were to:

- assess the outputs of funded research, including the alignment to Government strategic priorities at the time the research was funded
- assess and, where possible, quantify the economic impact of the Fund
- assess the broader impacts of the Fund, including environmental, social and other impacts
- compare the Fund's outcomes and impacts to equivalent international funds.

The assessment included all projects that commenced from 2016 and had submitted their final report by 30 August 2025, and all research grants awarded from 2016 to 2025. Active projects and other contestable research funds (such as the Marsden Fund and those administered by the Health Research Council) are outside the assessment's scope.

It is important to note that this impact assessment has come at a time of considerable funding and institutional reform across New Zealand's research and innovation system. Reform or re-design of the Fund has not been part of this project's scope.

Key findings

This report demonstrates that the **Fund has delivered significant and diverse benefits** to a broad range of end-users and beneficiaries in New Zealand. It shows how the Fund has supported a range of economic, social, environmental and cultural impacts over the life of the assessment period. It illustrates how funded research has contributed to the capacity and capability of New Zealand's innovation system, and public policy more broadly.

The report draws on a wide range of evidence and information sources to assess these impacts. They include: a survey of approximately 130 funded research leaders; final research project reports; a review of researcher-reported program data held by MBIE; data from public and international sources, including evaluation reports and data on outcomes for other competitive research funds; and a series of deep-dive case studies and vignettes illustrating exceptional research outcomes for New Zealand.

This evidence is analysed through a program-logic-based pathway to impact, which considers the relationships between MBIE's programme funding, research activities, research outcomes, and, ultimately, the impacts discussed in this report.

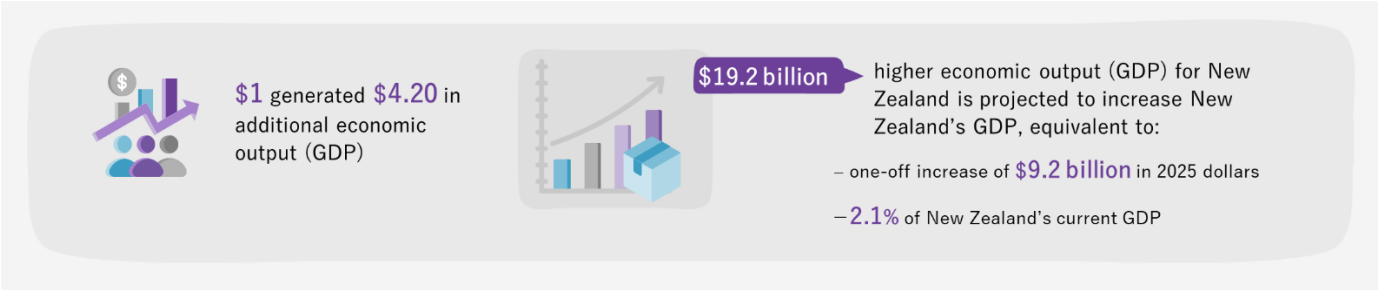
Economic impacts

ACIL Allen's in-house Computable General Equilibrium (CGE) model has been used to estimate the economy-wide impacts of research funded by Endeavour over the period 2016-2025 on the New Zealand economy. The model is a leading large-scale, dynamic CGE model of the world economy, developed in-house by ACIL Allen. The model enables economic analysis at the regional, state/provincial, national, and global levels, with results relative to a counterfactual scenario in which funds allocated to the Endeavour would have been allocated to general government expenditure.

Fund research spans diverse areas and generates impacts across economic, social, environmental, cultural and scientific capacity domains. Many of these impacts are challenging to quantify or assign monetary value. The economic analysis presented in this report captures only the direct and indirect economic effects of Endeavour-funded projects. Social, environmental, cultural and capability impacts have been evaluated empirically and qualitatively. When these and other unquantified benefits are factored in, the overall value delivered by the Fund likely substantially exceeds the estimates outlined in this report.

The figure below (Figure ES 1) highlights the key findings from the economic modelling, with more detail and methodology available in section 3 and appendix A. The modelling suggests that the value today of Endeavour's whole-of-life impact is equivalent to a one-time increase in the average income of all current residents of New Zealand by approximately $1,929 per person.

Figure ES 1 Summary of the economic impacts of Endeavour-funded research



Source: ACIL Allen

Note: All figures are exclusive of GST

Building research capacity and capability

Fund research has strengthened New Zealand's knowledge base, built lasting research capacity and capability, fostered extensive collaboration, and advanced research training. These contributions are evidenced through survey responses, final grant reports, vignettes, and case studies, as outlined below.

Funded projects have substantially enriched New Zealand's research outputs, including peer-reviewed publications, practical tools, datasets, and public resources. Survey data shows 95% of principal investigators reported positive academic impacts, such as new research directions and collaborations. Project reporting highlights that over 3,500 peer-reviewed articles (approximately $630k of funding per paper) were published between 2017 and 2024, as exemplified by case studies and vignettes.

The Fund has created a strong pipeline for New Zealand's research workforce, with 99% of survey respondents confirming it opened new research directions and up to 80% rating these gains as significant. Funding has catalysed partnerships across universities, public research institutes, industry, iwi, government, and international peers. These ties have accelerated translation into policy, tools, and commercial outcomes.

Funded projects have supported over 3,200 full-time equivalent (FTE) Masters and PhD students (about 6 per project) with Research Programmes driving 80% due to their scale. Smart Ideas excelled in supporting early-career opportunities by giving opportunities to participate in higher risk research projects that may otherwise not be available to researchers at these stages of their careers. These efforts sustain a skilled workforce, foster innovation spillovers, and enhance New Zealand's global research competitiveness.

Figure ES 2 Summary of the broader economic impacts of Endeavour-funded research



Source: ACIL Allen

Social, cultural and environmental impacts

Funded research projects deliver substantial social, cultural and environmental benefits that extend well beyond the economic metrics considered in this report. The case studies, vignettes, survey data and stakeholder consultation demonstrate that funding has enhanced community resilience, health outcomes and quality of life, while addressing challenges in natural hazards, housing and risk management. It has advanced environmental sustainability through evidence-based tools for better planning, biodiversity protection and habitat restoration. Critically, the Fund integrates and elevates Māori knowledge systems, Mātauranga Māori and tikanga, enabling iwi-led research, cultural revitalisation and equitable participation in New Zealand's science system.

Figure ES 3 Summary of the social, cultural and environmental impacts of Endeavour-funded research



Source: ACIL Allen

Case studies of exceptional research and impact

Four deep-dive case studies were selected to highlight the breadth and depth of impacts from Fund research. These examples demonstrate significant benefits to New Zealand and are summarised below, with fuller details sections 7 to 10.

- The **Fungal Factories** case study shows how Endeavour funding enabled New Zealand researchers to turn fungi into efficient "factories" for making complex natural compounds that are otherwise difficult and expensive to produce. By developing a modular DNA assembly platform and genome-editing tools, the team created a practical biomanufacturing route for high-value bioinsecticides, leading to new intellectual property, scientific publications and a spin-out company.
- The **Future Bees** case study shows how a multi-partner Endeavour programme built the scientific and practical foundations for a modern, genomics-based honeybee breeding system in New Zealand. The project developed new genetic tests, monitoring technologies and statistical models, along with standardised breeding procedures and a dedicated spin-out company, to help beekeepers select healthier, more productive bees and support pollination-dependent horticultural and honey export sectors.
- The **Augmented Nutrition** case study shows how a Smart Ideas project used Endeavour funding to develop a new hospital enteral feeding system that automatically adjusts feeding rates based on patient signals. Working closely with clinicians and industry, the team created a bench-top "phantom stomach", validated a way to measure relevant pressures outside the body using standard tubes, and built bedside prototypes and algorithms that are now being clinically evaluated and prepared for commercialisation through a New Zealand-based company.
- The **Remyelination Multiple Sclerosis** (MS) case study shows how a Smart Ideas project used Endeavour funding to pioneer the first potential treatment aimed at repairing nerve damage in MS. Led by researchers at Victoria University of Wellington in partnership with the University of Kentucky, the team discovered that activating a specific neurological pathway can trigger remyelination and recovery in MS models. By repurposing the existing drug nalfurafine and developing new compounds that enhance repair, the researchers created promising candidates for clinical use. Their findings led to 4 patents, award-winning publications, and the formation of Rekover Therapeutics, which is now advancing the therapy toward Phase 2 clinical trials in New Zealand and Australia.

The case studies demonstrate how the Fund's support for high-quality translational research can create new knowledge and tools that deliver enduring benefits across New Zealand's economy, environment, health and

community sectors. They highlight how researchers have leveraged different funding mechanisms to advance their programmes and generate value for diverse end-users, from industry and iwi, to policymakers and communities.

The economic impact of the case studies has been assessed by calculating their direct costs and benefits (present value, PV), along with the net present value (NPV) and benefit-cost ratio (BCR). The results of these analyses are summarised in the table below.

Table ES 1 Summary of case study cost benefit analyses (NPV and BCR at the 4% discount rate)

Case study	Funding mechanism	Present Value Costs	Present Value Benefits	Estimated NPV (million)	BCR
Augmented nutrition	Smart Ideas	$1.40m	$12.30m	$10.90m	8.83
Fungal Factories	Research Programmes	$13.32m	$72.02m	$58.71m	5.41
Future Bees	Research Programmes	$10.34m	$25.44m	$15.10m	2.46
Multiple sclerosis	Smart Ideas	$1.68m	$71.43m	$69.76m	42.63

Source: ACIL Allen

Note: All figures are exclusive of GST

Comparison with other research funds

Our impact assessment included a comparative exercise in which the Fund and several of its key metrics were assessed against a selection of 4 international research funding initiatives: the Australian Research Council's National Competitive Grants Program (NCGP), UK Research and Innovation's Strategic Priorities Fund (SPF), European Union's Horizon Europe, and Ireland's National Challenge Fund. While some of these international funds operate at a much larger scale, they provide valuable insights into how the Endeavour Fund might be strengthened in the future.

The comparison highlighted 3 broad dimensions of interest:

— the structure and logic of funding mechanisms (including research focus, co-contribution requirements, and success rates)

— the outcomes and impacts of funded research (such as alignment with government priorities and engagement with end-users)

— approaches to monitoring, analysing, and reporting on research outcomes and impacts.

This comparative perspective is particularly timely as significant structural changes are planned across New Zealand's research and innovation funding landscape. It offers a useful basis for reflection on how funds like Endeavour can be monitored, evaluated, and reported more effectively in the future.

Drawing on lessons from international practice, 3 key areas for improvement were identified: better automated tracking of research outputs, periodic national surveys of funded research leaders, and more systematic tracing of broader cultural and policy impacts from exceptional research.

Final remarks

Our findings suggest that the **Endeavour Fund is broadly effective and an appropriate mechanism for supporting research with the potential for adoption and commercialisation**. The Fund effectively balances strategic guidance with researcher autonomy while encouraging impact-focused planning from the outset. While some operational design choices, particularly around partnerships and co-investment, could be refined, its core model aligns well with international practice, and there is a clear need for such a fund into the future.

The analysis confirms that **Endeavour-funded research delivers broad, tangible impacts** across multiple domains. The Fund generates strong economic returns alongside scientific, social, cultural and environmental benefits, including new capabilities, start-ups, policy tools, biodiversity gains and Māori-led innovation. These span direct project outcomes and wider system spillovers.

The **Endeavour Fund's full value is still emerging and not yet fully captured**. Many long-term impacts, such as policy influence and capability building, remain underreported due to gaps in tracking and reporting. It is also crucial to recognise that the benefits of research take years to materialise, meaning some projects are simply too recent for their full impact to be seen. Adopting structured, ongoing impact measurement (as used internationally) would better demonstrate and maximise the Fund's contributions in the future.

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Main Report

1 Introduction

This section provides an overview of the Endeavour Fund and the scope of this impact assessment.

1.1 The Endeavour Fund

The Endeavour Fund (the Fund) is New Zealand's largest contestable research fund.[1] The Fund is administered by the Ministry of Business, Innovation and Employment (MBIE) and supports researchers in addressing major challenges and delivering transformative outcomes with the potential to positively impact New Zealand's economy, environment, and society, giving effect to the Vision Mātauranga policy,[2] and enhance New Zealand's focus on excellent research and impact in areas of future value, growth or critical need for New Zealand.[3]

Figure 1.1 shows the Fund's positioning relative to other government-funded science and innovation investments, by allocation method, investment type, and size. The Strategic Science Investment Fund guides significant investment in longer-term missions, while the Marsden Fund and Centres of Research Excellence provide investigator-led research funding. The Health Research Council complements the Fund by funding health outcomes-focused research.

While accurate at the time of writing this report, the New Zealand research funding system is undergoing significant reform in 2026 and beyond. This reform may alter the structure, naming and distribution of funds across the landscape to deliver a "simpler and more strategic system that helps researchers turn ideas into solutions that benefit New Zealand".[4] There is an opportunity to gather evidence for the continued value of funding, like the Fund, that progresses basic research towards more commercial outcomes that will deliver broad impact for New Zealand.

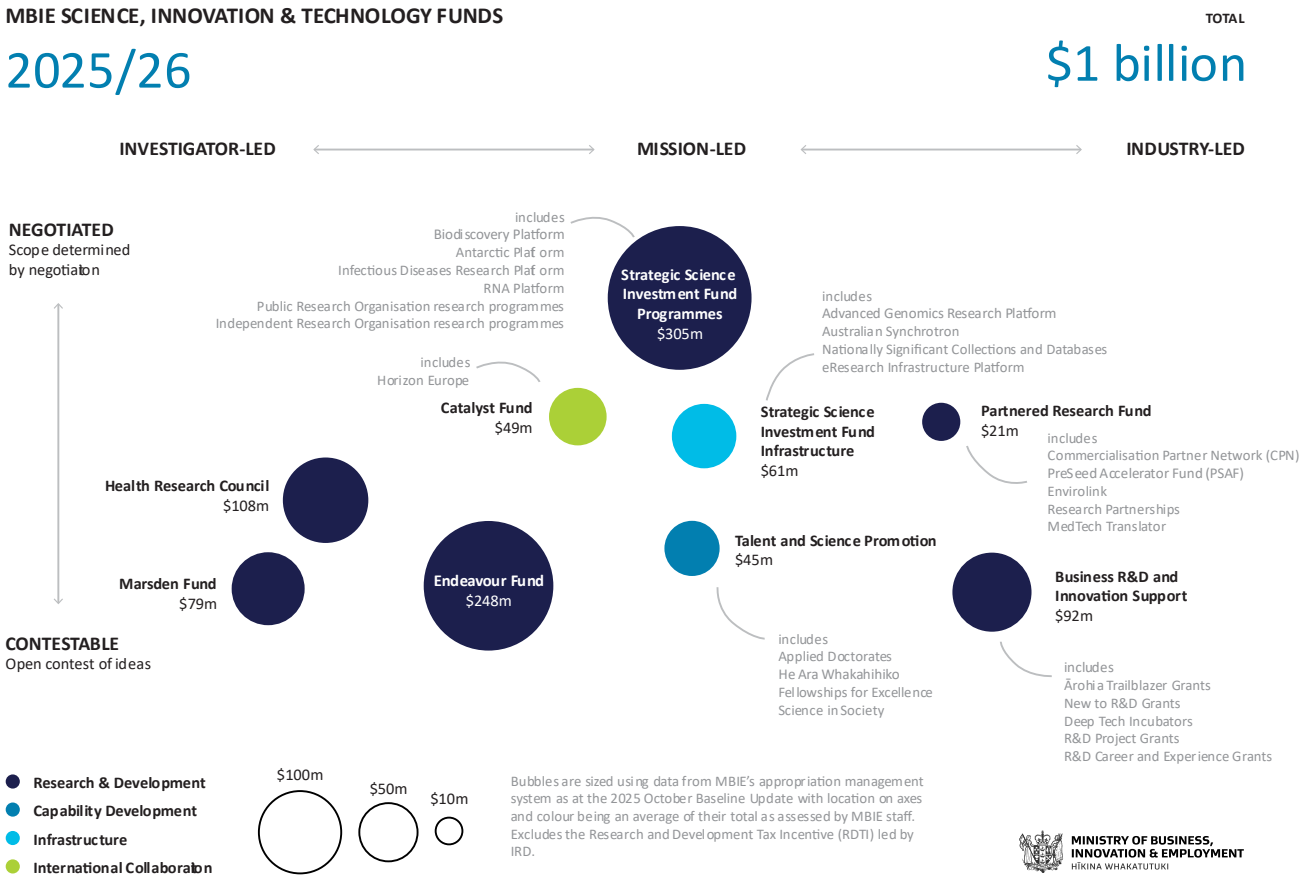
[1] Ministry of Business, Innovation and Employment (2024). *Endeavour Fund Investment Plan 2025-2027: Transforming New Zealand's future*. Accessed March 2026: https://www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/endeavour-fund/investment-plan-2025-2027-transforming-new-zealands-future.

[2] Ministry of Research, Science and Technology (2007). *Vision Mātauranga Unlocking the Innovation Potential of Māori Knowledge, Resources and People*.

[3] Ministry of Business, Innovation and Employment (2024). Op. cit.

[4] Ministry of Business, Innovation and Employment (2026). *A new funding strategy for the science system*. Accessed March 2026: https://www.mbie.govt.nz/science-and-technology/science-and-innovation/refocusing-the-science-innovation-and-technology-system/a-new-funding-strategy-for-the-science-system.

Figure 1.1 Positions of the Endeavour Fund in New Zealand's science funding system

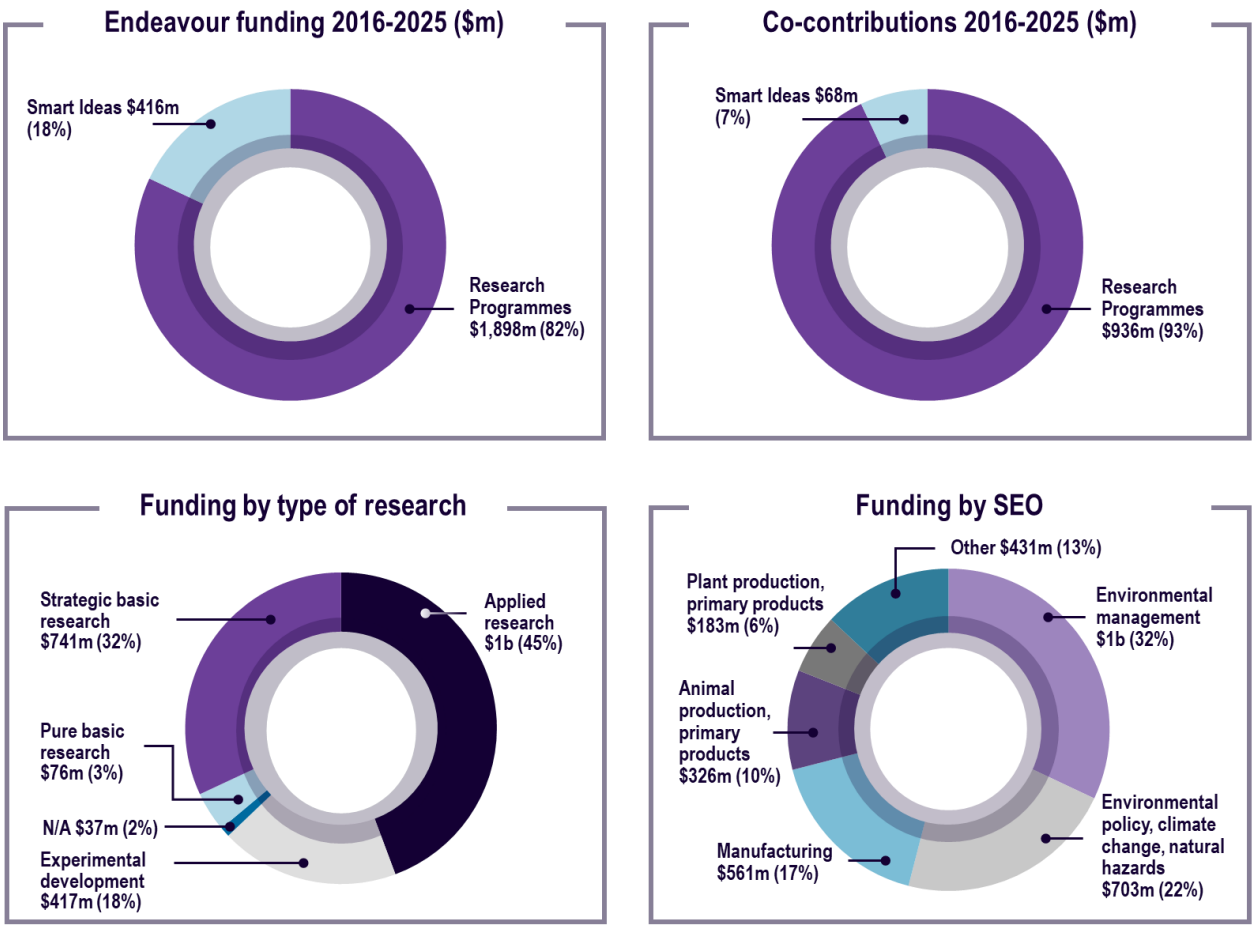


Source: MBIE 2021, Endeavour Fund Investment Plan 2022-2024, https://www.mbie.govt.nz/assets/endeavour-fund-investment-plan-2022-2024.pdf

Since the Fund's establishment in 2016, it has delivered $2.31 billion in funding to New Zealand's research and innovation system. An overview of the funding is provided in Figure 1.2. The Fund operates through 2 primary investment mechanisms designed to support different scales and stages of research, Smart Ideas (82% of research funding) and Research Programmes (18%). A total of $1 billion in co-contributions was received or committed across funded research, with most allocated towards Research Programmes (93%). Most funding was delivered to applied research and experimental development (with higher Technology Readiness Level, TRL, scales, 45%) and strategic basic research (32%).

An overview of each funding stream is provided below.

Figure 1.2 Funding delivered by the Fund



Source: ACIL Allen. Fund data.

Note: Data on funding by research type excludes data from 53 project for which data on type of research activity is missing.

Smart Ideas

Smart Ideas is designed to catalyse and rapidly test innovative research concepts with the potential to deliver significant benefits to New Zealand's economy, environment, or society. It provides opportunities for researchers to explore bold, creative, and potentially transformative ideas that may not yet have an established evidence base. Projects typically run for 2 to 3 years, with funding between $500,000 and $1 million available to support the investigation and validation of new concepts, technologies, or methodologies. Smart Ideas focuses on high-risk, high-reward research that could open new fields of inquiry, lead to breakthroughs in science or technology, or lay the groundwork for future large-scale research programmes and industry collaborations. Funding is available for projects at Technology Readiness Levels 2-4.

Research Programmes

Research Programmes support ambitious, high-quality, and strategically aligned research initiatives designed to achieve transformational outcomes for New Zealand. These multi-year programmes (typically 3 to 5 years) enable teams to pursue well-defined research agendas that address areas of clear national value, growth potential, or critical need, ranging from sustainable resource management to emerging technologies and social wellbeing. With a median award value of $9.3 million, these programmes aim to foster collaboration across disciplines and institutions, build capability, and deliver science and innovation

with enduring impact. The goal is to advance knowledge, enhance New Zealand's global research reputation, and provide tangible pathways to application and implementation. Funding is available for projects at Technology Readiness Levels 3-7.

1.2 Scope of this impact assessment

In late 2025, ACIL Allen was engaged by MBIE to undertake an independent impact assessment (the assessment) of the Endeavour Fund. The purpose of the assessment was to provide insight into the outcomes and impact resulting from research funded through the Fund.

The core objectives of the assessment were to:

- assess the outputs of funded research, including the alignment to Government strategic priorities at the time the research was funded
- assess and, where possible, quantify the economic impact of the Fund
- assess the broader impacts of the Fund, including environmental, social and other impacts
- compare the Fund's outcomes and impacts to equivalent international funds.

The assessment considered Smart Ideas and Research Programmes that have submitted a final report. To ensure consistency, the assessment included all projects that commenced from 2016 and had submitted their final report by 30 August 2025. The methodology used for the assessment is explained in the next section.

Active Endeavour Fund contracts and other contestable research funds (such as the Marsden Fund and those administered by the Health Research Council) were not to be included in the assessment.

It is important to note that this impact assessment has come at a time of considerable funding and institutional reform across New Zealand's research and innovation system. Reform or re-design of the Fund has not been part of this project's scope.

1.3 Report structure

Following a discussion of our impact assessment methodology in the next section, the remainder of this report is structured to address the core objectives of the assessment as outlined by MBIE. The report is structured in 3 parts.

- Part 1: *Impact report* provides the main outcomes of our assessment of the Fund's economic (section 3), research, social, cultural and environmental impacts (section 4). It also compares the Fund against funding mechanisms with similar objectives in selected countries (section 5).
- Part 2: *Case studies* provides the case studies developed to support the impact assessment. These showcase exceptional research and impact arising from Endeavour-funded projects and programmes. The outcomes of the case studies are also summarised in Part 1 of the report where relevant to the impacts we have assessed in this exercise.
- Part 3: *Appendices* provides the additional or supporting information that allows the reader to understand the impact assessment methodology and outcomes.

2 Methodology

This section outlines ACIL Allen's approach to assessing the Fund's impacts and the core data and evidence used. A more fulsome description of our methodology is provided in the Appendices.

Research supported through the Endeavour Fund spans a wide range of activities and generates diverse impacts across the economy, society, environment, and culture. These impacts can be grouped into several broad categories:

- **Economic impacts**: Benefits that can be assigned a measurable monetary value and are captured within the economy, such as increases in GDP, productivity, or employment.
- **Research capability impacts:** Contributions to knowledge creation, skills development, collaboration, and the strengthening of New Zealand's research capacity.
- **Social impacts**: Improvements in the wellbeing and resilience of communities, such as enhanced social cohesion or public health outcomes.
- **Environmental impacts:** Positive effects on natural systems spanning ecosystems, land, air, and water, and support for sustainable resource use.
- **Cultural impacts:** Advancements in cultural understanding, expression, heritage preservation, and creativity, including, in the case of Endeavour, contributions to mātauranga Māori and the aspirations outlined in MBIE's Vision Mātauranga policy (see Box 2.1).

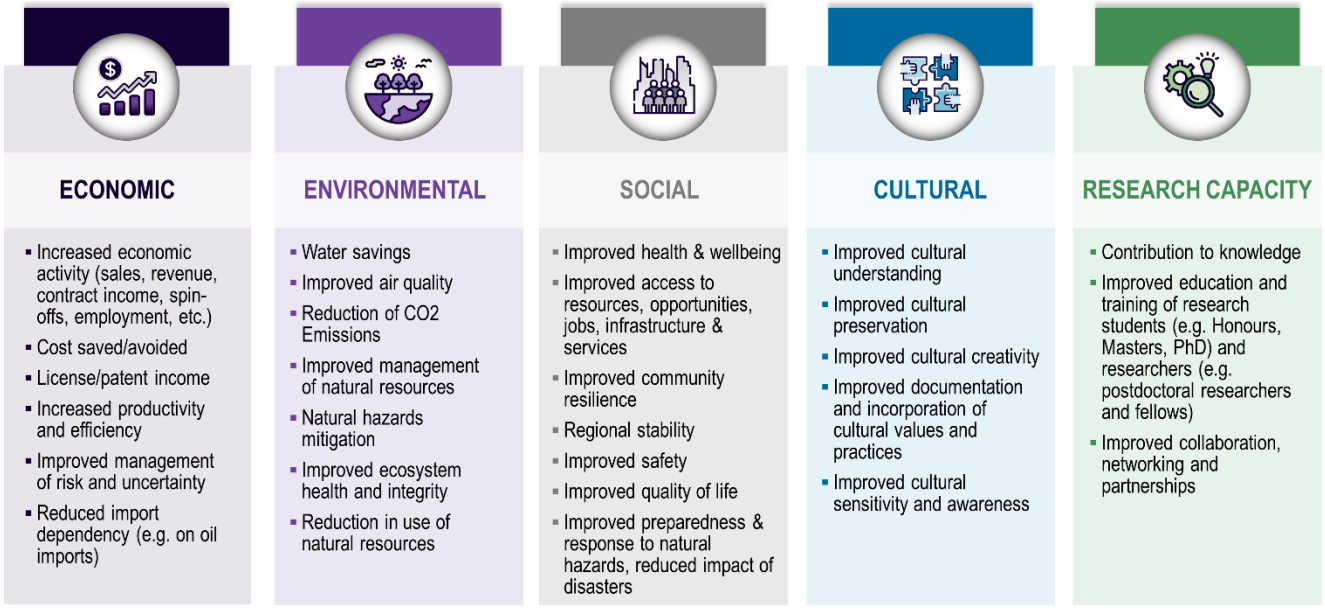
Examples of specific impacts across these categories are presented in Figure 2.1. Importantly, not all impacts can be readily quantified or expressed in monetary terms. For instance, changes in community resilience or cultural enrichment, while significant, are inherently qualitative. Recognising these intangible benefits is therefore essential to understanding the full value of Endeavour-funded research. In light of this, the impact assessment approach adopted in this analysis is designed to capture, as far as possible, both the quantitative and qualitative dimensions of the Fund's impact.

Box 2.1 Vision Mātauranga

Vision Mātauranga provides an essential lens for understanding and articulating cultural impacts within Endeavour-funded research. It emphasises the innovation potential of mātauranga Māori, Māori resources and Māori people, and highlights the importance of research that enables Māori to "live as Māori" and sustain their culture, language and identity. In the context of cultural impacts, Vision Mātauranga draws attention to outcomes such as the revitalisation of Māori knowledge systems, support for te reo Māori, strengthening of iwi and hapū connections to land and seascapes, and the protection and enhancement of sites, practices and traditions of cultural significance. These impacts extend beyond economic value, contributing to a richer, more inclusive research system and to the wellbeing of Māori while also delivering benefits for all New Zealanders by embedding indigenous perspectives, values and creativity in science and innovation.

Source: Ministry of Research, Science and Technology (2007). Vision Mātauranga Unlocking the Innovation Potential of Māori Knowledge, Resources and People.

Figure 2.1 Examples of research project impacts



Source: ACIL Allen

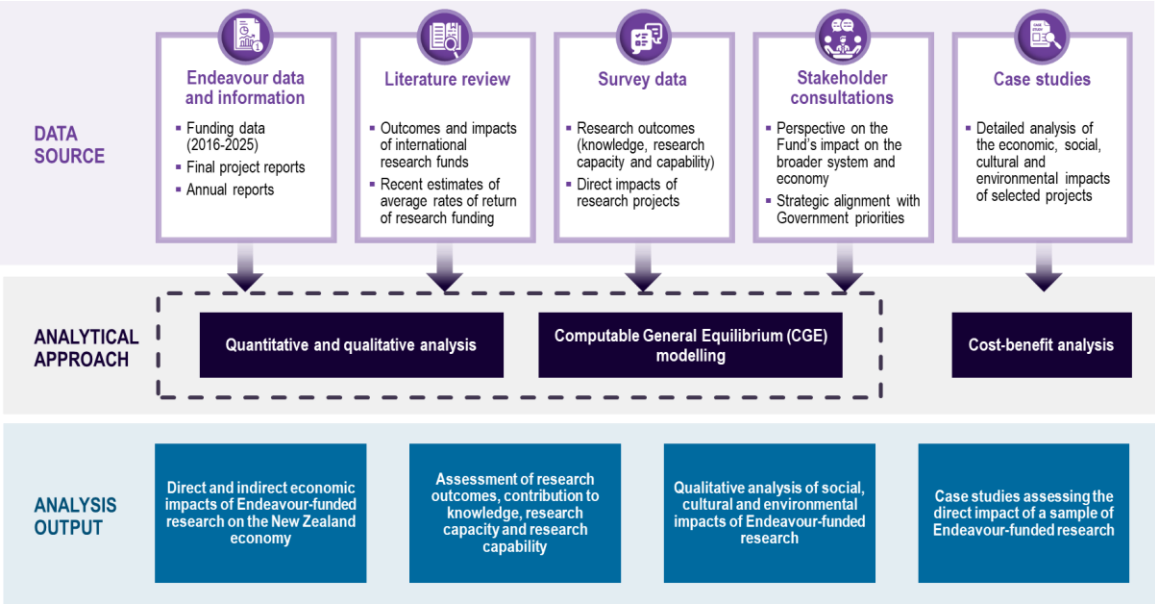
2.1 Impact assessment approach

The impact assessment used a mixed methods approach to gather and analyse qualitative and quantitative data (see Figure 2.2).

Core analytical components of the approach are described below, along with data limitations. These analytical components have informed an assessment of the pathway to impact for Endeavour-funded research. The report and case studies maps the relationship between inputs, activities, outputs, outcomes and impacts, which are economic, research capacity, social, environmental and cultural in nature. In doing so, it considers the benefits distributed, attribution issues, and the counterfactual. For the Computable General Equilibrium (CGE) modelling, these benefits are those delivered to each industry, while for the case studies, these benefits are those delivered to intermediate and end users.

See appendices A to C for more detail.

Figure 2.2 Impact assessment approach



Source: ACIL Allen

2.1.1 Computable-General Equilibrium (CGE) modelling

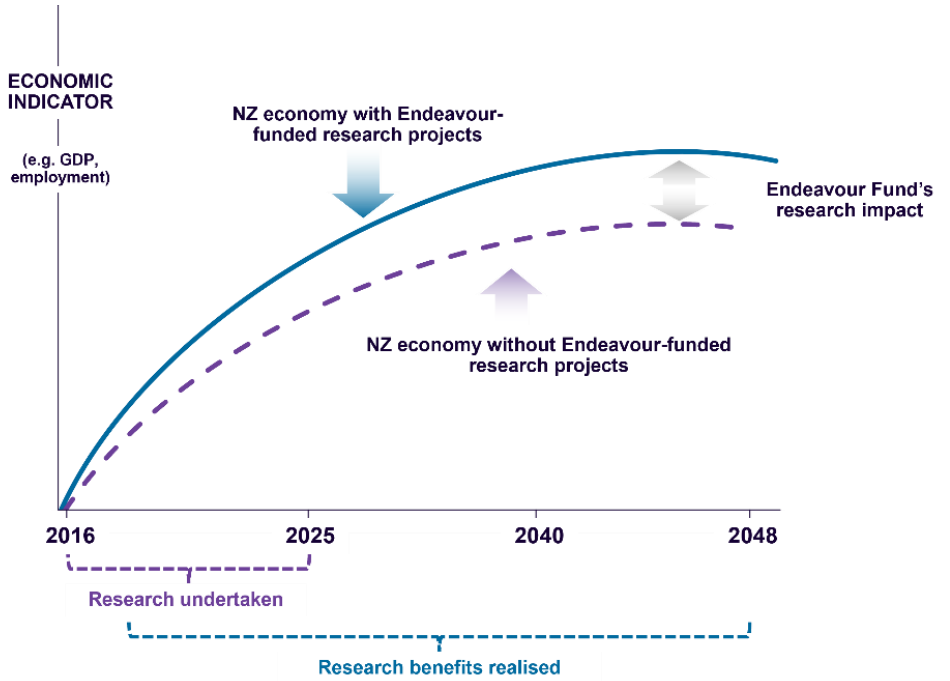
CGE modelling has been used to estimate the average economy-wide impacts of Endeavour-funded research over the period 2016-2025 on the New Zealand economy. The analytical framework used to assess these impacts is based on ACIL Allen's in-house Computable General Equilibrium (CGE) model of the global economy, Tasman Global. It is a leading large-scale, dynamic CGE model of the world economy, developed in-house by ACIL Allen, that enables economic analysis at the regional, state, national, and global levels. This model is routinely used to capture impact across public and private investment, including whole-of-economy research programs and institutes, and has been used in the past for initiatives such as the Australian Research Council's (ARC) National Competitive Grants (NCG) Scheme, the Australian Cooperative Research Centres (CRC) Program, the Australian Institute for Molecular Bioscience, the Australian Defence Industry Trailblazer Program, and Robotics development and adoption in Australia. Additional details on Tasman Global are provided in Appendix C.

CGE models mimic the workings of the economy through a system of interdependent behavioural and accounting equations linked to an input-output database. These models provide a representation of the whole economy, set in a national and international trading context, starting with individual markets, producers and consumers, and building up the system via demand and production from each component. When an economic shock is applied to the model, each market adjusts according to the set of behavioural parameters, which are underpinned by economic theory. An economic shock refers to any significant change that affects economic activity. For example, a major trade disruption (like new tariffs on key exports), a policy change (such as a carbon tax), a natural disaster, or a program like the Endeavour Fund. These shocks ripple through the economy, affecting prices, employment, production, and trade patterns.

In applications of the Tasman Global model, a reference case simulation forms a 'business-as-usual' basis with which to compare the results of various simulations (herein referred to as the Base Case or Business as Usual – BAU). The Base Case provides projections of growth in the absence of the project/change being analysed (e.g., Gross Domestic Product (GDP), population, labour supply, industry output), as well as

projections of endogenous variables[5] such as productivity changes and consumer preferences. The project case assumes all productivity improvements, tax rates, and consumer preferences change as per the Base Case projections, but also includes the project or policy being evaluated (in this case, the Endeavour Fund). The 2 scenarios give projections of the economy, and the net impact of the change is then calculated as deviations from the Base Case (see Figure 2.3).

Figure 2.3 Illustrative scenario analysis using Tasman Global



Note: In reality, impacts could be negative, positive, neutral or a mixture.

Source: ACIL Allen

The following scenarios were simulated in Tasman Global to measure the impacts of the Fund on the New Zealand economy:

— *Base Case scenario* — this scenario represents the projected path of the New Zealand economy under BAU assumptions regarding macroeconomic conditions and structural trends. It reflects the observed operating environment in which Endeavour funded research projects over the period 2016-2030. The Base Case serves as the reference point against which the alternative scenario is assessed.

— *Counterfactual scenario* — this scenario models a hypothetical case in which the Fund did not exist.

The economic impact of the Fund was estimated as the difference in economic outcomes between the Base Case and Counterfactual Scenario.

Two sets of shocks were applied to Tasman Global in the Endeavour simulation. One set of shocks is related to the direct benefits of the Endeavour-funded research activity, and the other to its costs.

The benefits of Endeavour-funded research are estimated using Endeavour project data, estimates of the rate of return (ROR) on public research investments obtained from the national and international literature (see Appendix B), and a number of assumptions (further detail of these is provided in Appendix A). The internal ROR used to calculate the benefits range from 5-70% per annum, depending on the sector and type of research. Based on this information, ACIL Allen estimated industry-specific productivity gains, which were

[5] Endogenous variables are economic factors that are determined within the model itself based on the interactions and relationships built into the model's structure (such as wages, prices, and employment levels), as opposed to exogenous variables which are set externally by the model user (such as population growth rates or government policy settings).

incorporated into the Tasman Global model. While the modelling captures Endeavour grants awarded between 2016 and 2025 (with funding for the final cohort extending to 2030 for grants of up to 5 years in duration), the benefits of Endeavour-funded research are not immediate. Instead, they typically emerge several years after project completion and can persist over an extended period. The modelling does not include the impact of projects funded in 2026 or in future funding rounds.

Taking these factors into account, the economic modelling spans from 2017 to 2048. The start year reflects the assumption that funding effectively begins in the calendar year following the grant award (for example, a project commencing on 1 October 2016 is treated as having its first year of research expenditure in 2017). The end year, 2048, represents the final year in which direct benefits are realised from projects awarded in 2025 and completed in 2030.

In terms of research costs, it has been assumed that, in the absence of the Endeavour Fund, the funds allocated to the program would have been allocated to general government expenditure (potentially having positive impacts elsewhere). An alternative counterfactual assumption could be that the amount of Endeavour funding could have lowered taxes.[6] However, given the scale of Endeavour funding in the overall New Zealand Government budget, it is more likely that the funds would have just been differently allocated out of consolidated government revenue.

Additional details of the modelling approach are provided in Appendix A.

2.1.2 Case studies and vignettes

The case studies involved desktop research, analysis and consultation with researchers, research partners and end-users on a sample of 4 projects. Project examples with available evidence of impact were chosen to demonstrate the diversity of impact types, beneficiaries, disciplines, participating organisations and Endeavour schemes, noting that 4 case studies cannot illustrate the full diversity of Endeavour-funded research and its impacts.

These illustrate the pathways to impact and highlight the diversity of impact delivered by Endeavour-funded research. This includes impact on society, culture, environment and research capacity, which may not be as readily quantified nor generate a market return. The case studies are provided in full in Part 2 and overviewed below:

— *Fungal Factories* focused on using advanced fungal biotechnology to produce valuable natural compounds at scale, particularly safer insect-control products for use in agriculture and animal health.
— *Future Bees* focused on developing modern bee-breeding methods and tools, and supporting commercial delivery of these, to produce healthier, more productive bee stocks that strengthened honey production and crop pollination.
— *Augmented Nutrition* focused on designing an enteral feeding system that used patients' physiological signals to automatically adjust tube-feeding rates, with the aim of optimising nutrition delivery and supporting future clinical use.
— *Remyelination in MS* focused on repurposing nalfurafine and novel compounds to promote nerve repair and remyelination in multiple sclerosis, paving the way for a first-ever recovery therapy now advancing to Phase 2 clinical trials.

[6] An alternative counterfactual assumption that taxes are lowered by the amount of Endeavour funding in the absence of the program would have resulted in a reduction of the deadweight losses associated with taxation and a reduction in the estimated impacts of the program. The extent of this reduction would depend on the taxes that are assumed to have been reduced.

A set of 6 vignettes were similarly chosen to showcase the diversity of the research, as well as the more qualitative impacts that could not be readily quantified. The vignettes are provided throughout section 4 and overviewed below:

- *Predator Free NZ* focused on understanding why some invasive predators survived current control methods and developing new sensory lures and culturally informed approaches to more effectively remove these remaining animals.
- *Personalised Medicine for Movement Disorders* focused on replacing largely visual clinical assessments with quantitative measurement tools and computational analysis, in order to improve diagnosis and enable more tailored treatment for people with movement disorders.
- *Maximising Workforce Participation for Older New Zealanders* focused on investigating the experiences and needs of older workers, and translating this evidence into policy, employer practices and resources that better supported ongoing participation in work.
- *Lake Ecosystem Models* focused on creating a national modelling platform that used environmental data to project lake water quality and habitat conditions, informing decision-making on the management and restoration of New Zealand lakes.
- *Fermented Foods* focused on enhancing food-grade microbes and related technologies to develop higher-value fermented products, supporting growth in New Zealand's premium food export sectors.
- *Novel Infant Formula* focused on focused on developing human-milk-fat-mimicking emulsions using microalgal oils and dairy phospholipids, offering a more sustainable and nutritious alternative to palm oil-based infant formula while also meeting the nutritional needs of older adults.

2.1.3 Consultation with system leaders in New Zealand

Stakeholders were consulted from the following New Zealand organisations: Ministry for the Environment; Ministry of Education; NEMA; Royal Society; Health Research Council; DPMC; MBIE; Science NZ; IRANZ.

Consultation questions were organised around a core evaluation of whether the Fund is delivering meaningful outcomes and impacts across economic, environmental, social, and cultural dimensions. Questions also considered how well those impacts align with New Zealand Government priorities and Vision Mātauranga, and the extent to which the Fund adds unique value to the science and innovation system compared with other funding sources and international peers.

2.1.4 Consultation and comparison with international comparator programs

Four international organisations were selected in consultation with MBIE for comparison with the Endeavour Fund. This focused on the structure and logic of the funding, research impacts, and efforts to monitor, measure and report on impact.

Stakeholders were consulted from Horizon Europe, European Commission (Horizon Europe), Research Ireland, and the United Kingdom Research and Innovation (UKRI).

Given ACIL Allen's previous work on the ARC's National Competitive Grants Program, this was also used as a further point of comparison.

2.1.5 Funding data and report data

Funding data was provided for 623 projects. This included the funding commencement year and project duration, and announced funding value, totalling over $2.3 billion (exclusive of GST).

MBIE collects annual updates and final reports from its funding recipients. These reports ask questions about progress and research outputs, including peer-reviewed publications, new products and patents, conference presentations, and the number of students supported in pursuit of doctoral and master's qualifications, among others.

Analysing responses to these questions using the available data has proved challenging for several reasons. The wording and structure of questions change from year to year, and in 2024, the underlying data system shifted between the various record-keeping systems of the Government. Although efforts have been made to verify the accuracy and consistency of data across these systems, some inconsistencies and gaps are likely to remain, and these should be considered when interpreting the findings presented here. Where possible, we have taken lower-bound estimations.

2.1.6 Survey of researchers

A survey was distributed to 319 researchers awarded Endeavour grants from 2016-2025. A total of 131 responses were received, approximately 41% of the potential 319 respondents. This strong response rate enabled analysis that more accurately reflects the broader population of grant recipients.

The survey aimed to address project data gaps and provide an updated summary of the impacts delivered by Endeavour-funded research, given an extended lag time for impacts to emerge. It asked questions about involvement in Endeavour-funded research, the nature of the research, the nature and extent of impacts delivered/likely to be delivered, the lag time to and duration of impact, beneficiaries, and other funding sources. The survey population is overviewed in the figure below.

Figure 2.4 Overview of the survey population



Source: ACIL Allen survey of Endeavour funding recipients

2.2 Interpreting the outcomes of the impact assessment

This report is an impact assessment exercise based on whole-of-economy modelling, impact tracing through case studies, surveys of researchers and participants, consultations with selected experts, and international comparison. Many parts of the analysis rely on assumptions and the best available data. As such, the results

of this assessment should be interpreted as an illustration of the types and nature of the impacts delivered over time.

As modelled and analysed, the results are not strictly comparable to other modelling undertaken for the research sector or even other sectors that receive public funding, although some of these comparisons are presented in Part 2 as an illustration of relative impact. This is because the assumptions and data (based on best practice and best available information) used in this report are unique to the assessment of the Fund and New Zealand's unique innovation characteristics and economic structures.

Moreover, the following data limitations were encountered during the assessment. These should be considered throughout the report when referencing or using the relevant data/analyses.

- A small sample of 4 deep dive case studies was selected. While the case studies and their underlying methodology are consistent with international best practice evaluation of research, they are not representative of the breadth of research funded under the Fund. Due to the nature of the impacts generated by some projects, it was neither appropriate nor possible to quantify certain benefits. Where this occurs, impacts have been discussed qualitatively.
- Domestic stakeholders had limited visibility or capacity to articulate the breadth and depth of the impact delivered by the Fund and limited visibility of MBIE's support mechanisms and communications. Many stakeholders are peak bodies with members that are at varying levels of maturity in assessing their impact, and as such, there was no consistent view on impact measurement.
- International stakeholders represented schemes of varying comparability to the Fund and were at varying levels of impact measurement maturity. Some, of course, operate at completely different scales or within different institutional settings, which further limits the degree to which definitive conclusions can be drawn from the comparisons section.
- Final report data has changed over time as questions, data types, response options and collection approaches have varied over time and across schemes. Outputs and outcomes may be underestimated because not all final reports were submitted at the time of data extraction, and they do not capture benefits realised after final reports were submitted (no later than 12 months post grant completion).
- The 41% of grant recipients who responded to our survey represented approximately 21% of the recipients who were awarded grants during our evaluation period (i.e. between 2016 and 2025). Some grants were ongoing at the time of the survey, and impacts had not necessarily emerged.

In addition, as with any modelling exercise, there are some broader limitations to the analysis, as follows:

- The social, cultural, environmental and other impacts associated with research projects funded by Endeavour have not been monetised or included in the economic modelling. As a result, the economic impacts described in this report understate the Fund's overall impact.
- The economic modelling assumes that the economic returns from Endeavour-funded research projects are, on average, similar to those found in the literature. Potentially, these may be higher or lower for some projects we have considered in this assessment. Accurate estimation of rates of return for Endeavour-funded projects would require detailed and lengthy analysis of each of the 623 projects that received funding over the 2016-2025 period, which are beyond the reasonable bounds of this assignment.
- The findings in this report are subject to unavoidable statistical variation. While all care has been taken to ensure that the statistical variation is kept to a minimum, care should be taken whenever using this information. This report considers information provided by MBIE up to the end of 2025. The findings may be affected by new information collected after this date.

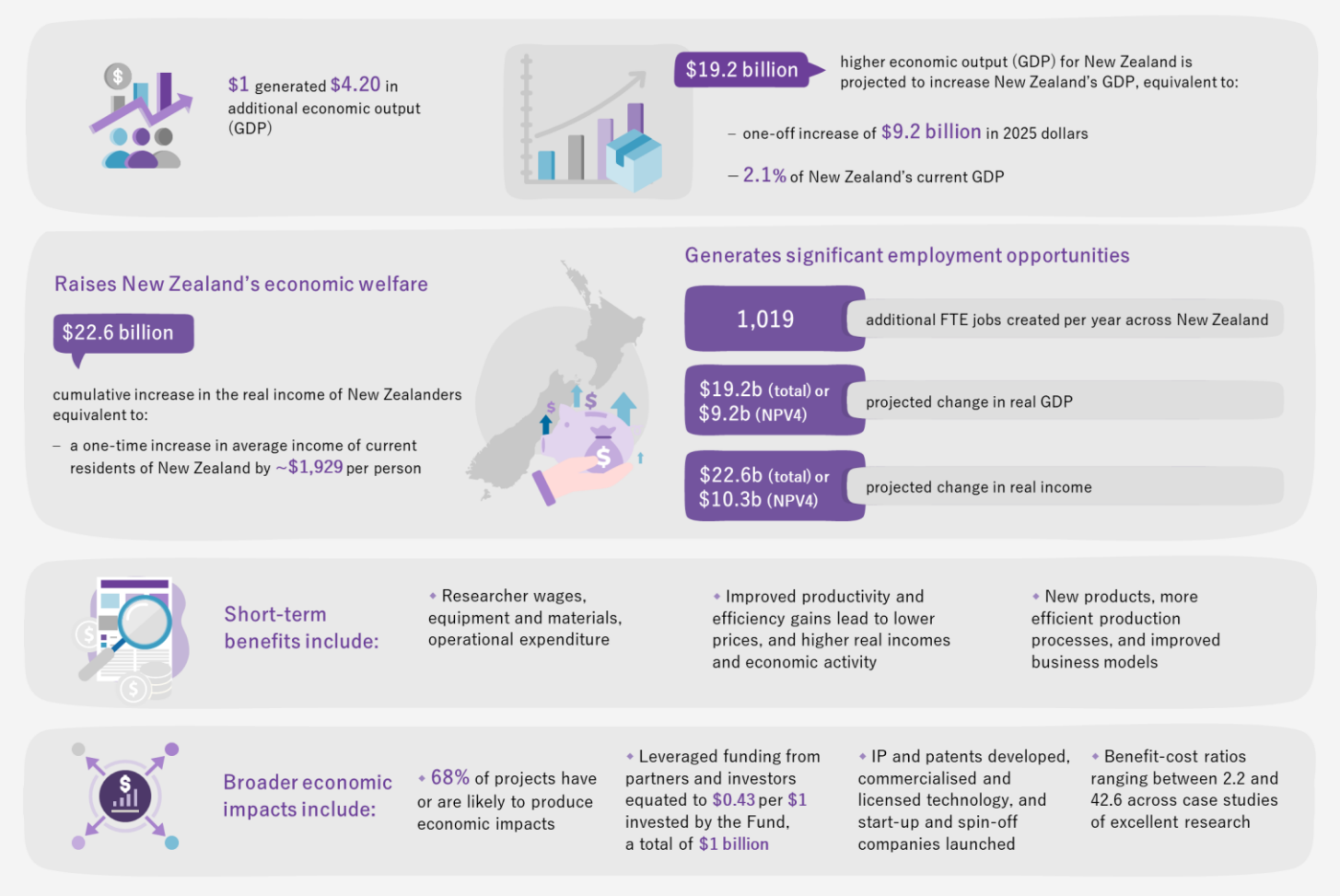
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Part 1: Impact report

3 Economic impacts

This section details the modelled and other economic impacts generated by the Endeavour Fund over the past decade.

Finding 1 Economic impacts



3.1 Measured economic impacts

As mentioned in section 2, in this analysis, the research capability, social, environmental, and cultural impacts of the Fund have not been monetised. Consequently, the economic impacts presented in this section represent only a portion of the total benefits generated through Endeavour-supported projects.

When assessing the impacts of research activities on the economy, a range of key macroeconomic variables are commonly evaluated (and have been included in other economy-wide studies of research impacts), including the following.

— **Gross Domestic Product (GDP)** — real GDP measures the value of goods and services produced within New Zealand, adjusted for inflation. This indicator captures changes in aggregate economic output attributable to Endeavour-funded research. The term 'economic output' has been used in the discussion of the relevant results presented in this report.

— **Real income** — measures changes in national economic welfare by capturing the purchasing power of income after accounting for price effects.

— **Employment** — reflects changes in total jobs supported across the New Zealand economy, including direct and indirect effects.

The sections below discuss the impacts of the Endeavour-funded research on these key macroeconomic variables for the New Zealand economy.

All of the economic impacts in this section are reported in New Zealand dollars (in 2025 dollars unless noted) and the net present valuations (NPV) are calculated over the period (2017-2048) using a central 4% real discount rate (with sensitivity analysis for a lower 2% rate and higher 8% discount rate presented in tables).[7]

Notably, the economic impact figures in this section reflect the combined impacts of Fund funding and co-contributions associated with grants awarded between 2016 and 2025, with funds expended over 2017-2030 and benefits continuing through to 2048.

3.1.1 Economic output

Endeavour-funded research increases economic activity through a series of effects that extend beyond the initial grant investment. In the short term, funding flows directly into the economy through wages for researchers, procurement of equipment and materials, and operational expenditure at universities and research organisations. This expenditure supports activity across supply chains and generates additional household spending.

The more significant and enduring impacts arise over time through improvements in productivity. As new knowledge, technologies and methods are developed and adopted by firms, industries are able to produce more output using the same level of inputs. This increases the productive capacity of the economy and reduces production costs. Over time, these efficiency gains are passed through to consumers in the form of lower prices, higher real incomes, and increased economic activity across the wider economy.

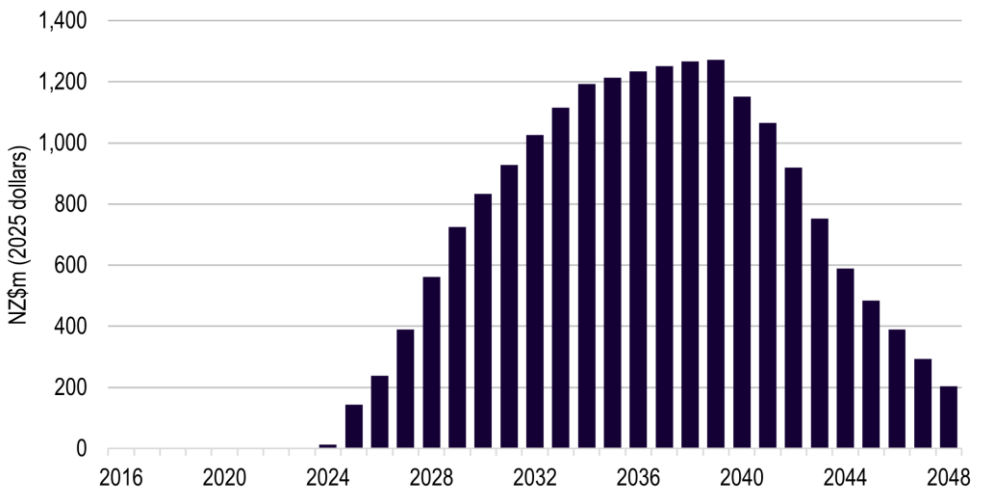
The economic benefits of Fund investments do not occur immediately. There is typically a lag between research being undertaken and the point at which it is translated into commercially relevant applications. Once realised, however, the impacts tend to be both substantial and long-lasting. Research outcomes contribute to new products, more efficient production processes, and improved business models. At the same time, research investment strengthens the economy's stock of human capital by training highly skilled graduates who move into industry, and it supports the development of research capability, collaboration networks, and new methodologies that enable future innovation.

Figure 3.1 shows the impact of funded research on New Zealand's real economic output (GDP). The figure reflects the combined impacts of Fund funding and co-contributions associated with grants awarded between 2016 and 2025, with funds expended over 2017-2030 and benefits continuing through to 2048, as outlined in section 2.1.1. If funding were assumed to continue at its current level beyond this period, the economic impacts would not decline over time, as illustrated in the figure.

[7] New Zealand's Treasury guidance recommends that public sector cost benefit analyses for non-commercial proposals apply a real discount rate based on the social rate of time preference (SRTP), which is set at 2% for years 1–30, declining to 1.5% for years 31–100 and 1% thereafter. This approach reflects society's preference for present versus future consumption and is appropriate for investments with long-term, public-good characteristics such as research funding. Higher rates (e.g. 8%) based on the social opportunity cost of capital (SOC) are reserved for commercial proposals, while sensitivity testing at alternative rates is recommended. For this analysis, MBIE directed the use of a central discount rate of 4%, with sensitivity testing at 2% and 8%. This reflects the mixed nature of Endeavour-funded research, which generates both non-commercial (e.g. productivity spillovers) and commercial benefits. While Treasury guidance would support a lower rate for predominantly non-commercial impacts, adopting a 4% cent central rate provides a balanced and defensible position. The selected range for sensitivity testing remains consistent with Treasury guidance, and the central rate is broadly aligned with international practice (for example, 3.5% in the United Kingdom and 4% in the United States).

The benefits of Endeavour-funded research take time to translate into measurable economic activity. However, after the initial years of the modelling period, the impacts increase substantially as earlier investments in research begin to translate into higher productive capacity across the economy. As productivity improves, GDP increases relative to the counterfactual due to the additional economic activity generated by research-related innovation. Over the longer term, productivity gains in key industries are reflected in lower prices for goods and services. This frees up resources for use elsewhere in the economy, allowing total production to increase. Lower prices, together with stronger productive capacity, lead to higher real private consumption and higher overall economic activity. The effect on GDP is projected to peak in 2039 at $1.3 billion above the counterfactual scenario.

Figure 3.1 Estimated change in New Zealand real GDP associated with Endeavour grants awarded between 2016 and 2025, relative to the counterfactual (2025 dollars)



Source: ACIL Allen

Table 3.1 summarises the estimated change in real economic output resulting from Endeavour-funded research in both cumulative and NPV terms. The table also compares the investment (cost) of this research with the projected increase in economic output.

As shown in this table, Endeavour-funded research awarded between 2016 and 2025 is projected to increase New Zealand's GDP by a cumulative total of $19.2 billion over 2017-2048 relative to the counterfactual over the life of the benefits. This is equivalent to a one-off increase of $9.2 billion in 2025 dollars (using a 4% real discount rate).

To place these results in context, the discounted present value of the increase in New Zealand's economic output is equivalent to:

— around 2.1% of New Zealand's current GDP[8]

— larger than the size of New Zealand's accommodation and food services industry in 2025 (which had a GDP of $8,433 million[9])

— almost 6% of Auckland's current GDP[10].

[8] The size of the New Zealand economy in current prices is $445 billion as of December 2025. Source: Stats NZ, https://www.stats.govt.nz/indicators/gross-domestic-product-gdp/, accessed 19 March 2026.

[9] Gross domestic product by industry, year to March 2025, 2025 prices. Source: Infometrics, https://regions.infometrics.co.nz/new-zealand/economy/structure, accessed 19 March 2026.

[10] Auckland's GDP was $164,964 million in the year to March 2025, 2025 prices. Source: Infometrics, https://regions.infometrics.co.nz/new-zealand/economy/structure, accessed 19 March 2026.

The modelling also shows that the benefits generated by Endeavour-funded research substantially exceed the costs to the New Zealand Government of grants awarded between 2016 and 2025 (and the costs to the co-contributors to this research).

— Total funding for research projects awarded Endeavour funding over this period is $4.0 billion in 2025 dollars ($3.23 billion in present value terms using a 4% discount rate).

— For every $1 invested by the New Zealand Government and co-contributors in Endeavour-funded research, cumulative GDP over 2017–2048 is estimated to be $2.8 higher (on a 4% real discounted basis) than it would have been if the funding had been allocated elsewhere.

— While other funding sources contributed to these outcomes, their impact was leveraged through Fund support. On this basis, when considering only New Zealand Government investment, each $1 invested in the Fund between 2016 and 2025 is estimated to generate $4.2 in cumulative GDP over 2017–2048 (on a 4% real discounted basis), compared with allocation to general government expenditure.

These estimates are broadly consistent with returns estimated for public research investment in other contexts, noting that methodological differences preclude direct comparison. For instance, the ARC's NCGP program has been estimated to return approximately $1.6–$3.3 per dollar invested in GDP terms (refer to Section 5.3.2). More broadly, as the review in Appendix B suggests, the literature on returns to R&D finds that social returns to public research investment are typically high (often in the range of 20%–50% annually) reflecting the long-time horizons over which research generates economic value. While these estimates are derived using different models, time horizons, and counterfactuals, the Fund's estimated return sits within the range commonly found for comparable public R&D investments internationally.

These returns reflect not only the direct outputs of funded projects, but also the broader role that a strong and well-functioning research base plays in supporting productivity growth and long-term economic performance.

Importantly, as discussed in section 4, Endeavour-funded research generates a wide range of additional benefits that are not captured in the quantified modelling results. These include increasing the stock of useful knowledge, training highly skilled post-graduates (many of whom work outside academia), developing new research methodologies, and strengthening knowledge-exchange networks. Once these broader benefits are considered, the overall value of the Fund is likely to be significantly higher than the quantified estimates presented here.

Table 3.1 Estimated change in New Zealand real GDP associated with Endeavour grants awarded between 2016 and 2025, relative to the counterfactual (NZ$m 2025 dollars)

	Annual average	Total (2017-2048)	Net present value (2017-2048)		
			2%	4%	8%
Real GDP	601	19,248	13,162	9,164	4,670
Endeavour funding					
New Zealand Government funding	195[a]	2,735 [b]	2,430	2,173	1,766
Co-contributions	90	1,262	1,153	1,057	897
Ratio of increase in GDP to total funding	2.1	4.8	3.7	2.8	1.8
Ratio of increase in GDP to NZ Government funding	3.1	7.0	5.4	4.2	2.6

[a] Annual average MBIE funding over 2017-2030 (while the last round of grants modelled are those awarded in 2025, there are projects awarded in 2025 which will receive funding over 5 years – until 2030 – and hence the costs to the New Zealand Government extend from 2017-2030).

[b] Refers to MBIE funding over 2017-2030 (while the last round of grants modelled are those awarded in 2025, there are projects awarded in 2025 which will receive funding over 5 years – until 2030 – and hence the costs to the New Zealand Government extend from 2017-2030).

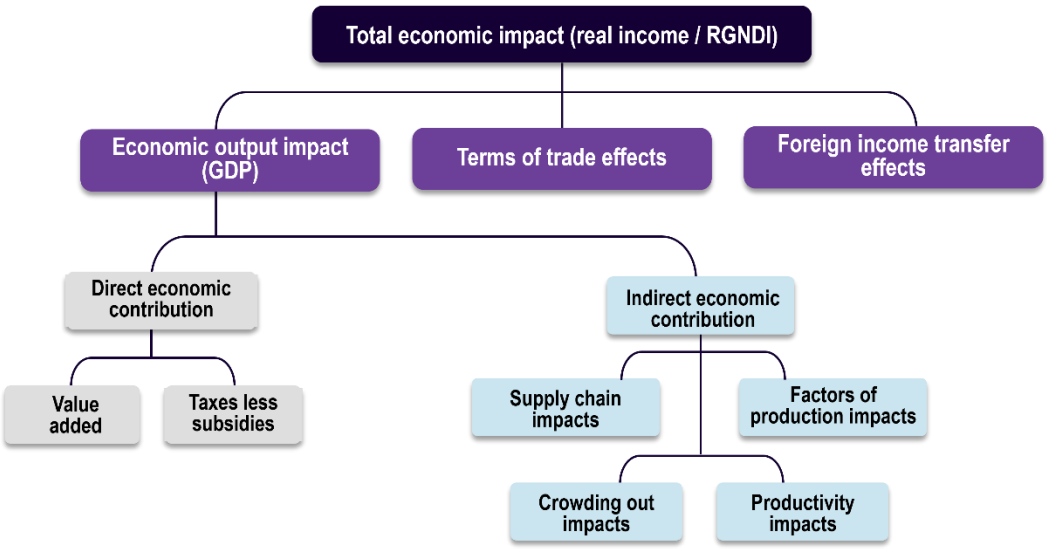
Source: ACIL Allen

3.1.2 Real income impacts

While GDP measures the level of economic activity, it does not fully capture changes in economic wellbeing as represented by household purchasing power. It is possible for output to increase without a corresponding improvement in wellbeing. For this reason, real income is often considered a more informative measure of welfare.

Real income reflects the purchasing power of households and businesses, adjusted for inflation. The change in real income is equal to the change in real economic output (real GDP) plus the change in international income transfers, plus the change in the nation's terms of trade (which measures the purchasing power of the nation's exports relative to its imports) (see Figure 3.2). An increase in real income indicates greater capacity for consumption and savings, and therefore an improvement in economic welfare.

Figure 3.2 Impact of a program or policy on real income



Source: ACIL Allen

The projected changes in real income associated with the Endeavour research investments are shown in Figure 3.3 and Table 3.2. Overall, as shown in Figure 3.3, the pattern of changes in income is similar to the pattern of changes in output, but income gains are slightly higher than the change in economic output. As shown in Table 3.2, from 2017 to 2048, Endeavour-funded research is projected to increase the real income of New Zealand as a whole by a cumulative total of $22.6 billion relative to the counterfactual. This is equivalent to a one-off increase in real income of $10.3 billion (in 2025 dollars, using a 4% real discount rate).

These results indicate that the additional economic activity associated with research funded by the Fund translates into measurable gains in purchasing power for New Zealanders, rather than simply higher gross output.

To place these estimated changes in income in perspective, expressed in today's dollars (present value terms), the value today of this whole-of-life impact is equivalent to a one-time increase in the average income of all current residents of New Zealand by approximately $1,929 per person.[11]

While these per-person figures may appear modest when spread across the whole population, they represent a considerable aggregate increase in consumer welfare.

[11] That is, the discounted present values of the projected changes in real income using a 4% real discount rate.

These income gains also have implications for New Zealand's productivity performance. Over the past 5 decades, labour productivity growth in New Zealand has lagged that of comparable advanced economies, resulting in a widening gap between New Zealand's GDP per hour worked and that in similar economies.[12] While some drivers of this gap are structural (such as geographic remoteness, small domestic markets, and industry composition) and hence difficult to address through policy, this low productivity growth also reflects costs and incentives for investment, innovation and competition. Indeed, evidence cited by the IMF[13] highlights several constraints to innovation in the country, including declining rates of product innovation across both large and medium-sized firms, relatively low and recently declining business expenditure on R&D, and slower diffusion of frontier technologies, with leading New Zealand firms operating significantly below the productivity levels of their international peers.

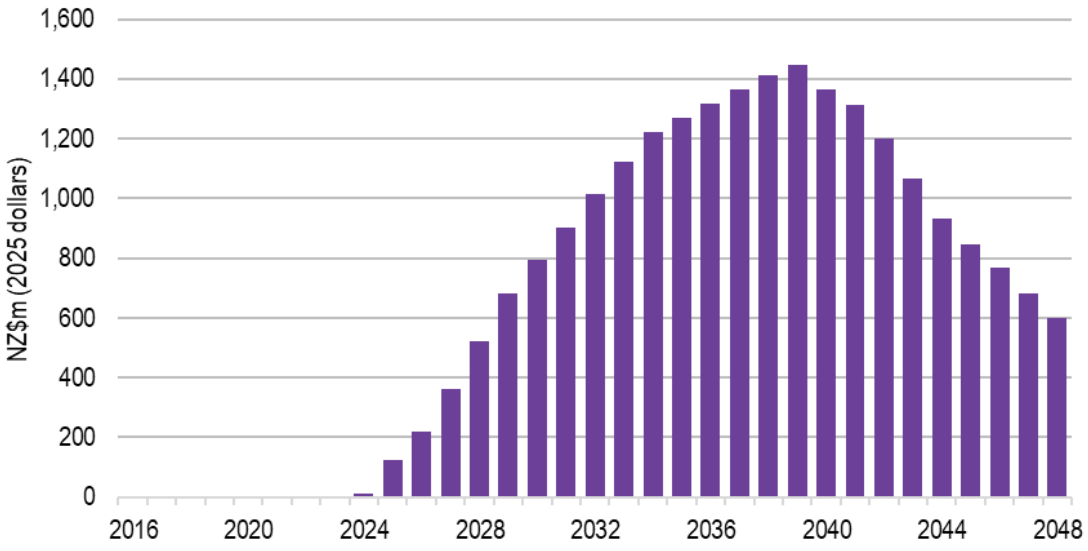
Endeavour-funded research is targeted at this innovation gap. By expanding the stock of knowledge and strengthening linkages between research institutions and industry, the Fund supports both the generation and diffusion of innovation. Over time, improved technology and innovation allow for a more efficient mix of capital and labour and facilitate the adoption and adaptation of new technologies across firms.

The income gains estimated in this report can, in this sense, be interpreted as a partial measure of the resulting productivity dividend associated with Endeavour-funded research. They reflect the cumulative impact of incremental improvements in firm performance and resource allocation, directed at structural constraints that have weighed on New Zealand's productivity over an extended period.

Table 3.2 also shows that for every $1 invested by the New Zealand Government and co-contributors in Endeavour-funded research, cumulative income over 2017–2048 is estimated to be $3.2 higher (on a 4% real discounted basis) than it would have been if the funding had been allocated elsewhere.

This is a sizeable return in consumer welfare in the context of a research program.

Figure 3.3 Estimated change in New Zealand real income associated with Endeavour grants awarded between 2016 and 2025, relative to the counterfactual (2025 dollars)



Source: ACIL Allen

[12] Petrescu, M. (2025). New Zealand's Productivity Challenge: New Zealand. Selected Issues Papers, 2025(075), Article A001, A001. Retrieved Apr 23, 2026, from https://doi.org/10.5089/9798229012317.018.A001

[13] Ibid.

Table 3.2 Estimated change in New Zealand real income associated with Endeavour grants awarded between 2016 and 2025, relative to the counterfactual (NZ$m 2025 dollars)

	Annual average	Total (2017-2048)	Net present value (2017-2048)		
			2%	4%	8%
Real income	705	22,576	15,102	10,304	5,068
Endeavour funding					
New Zealand Government funding	195	2,735	2,430	2,173	1,766
Co-contributions	90	1,262	1,153	1,057	897
Ratio of increase in income to total funding	2.5	5.6	4.2	3.2	1.9
Ratio of increase in income to NZ Government funding	3.6	8.3	6.2	4.7	2.9

[a] Annual average MBIE funding over 2017-2030 (while the last round of grants modelled are those awarded in 2025, there are projects awarded in 2025 which will receive funding over 5 years – until 2030 – and hence the costs to the New Zealand Government extend from 2017-2030).

[b] Refers to MBIE funding over 2017-2030 (while the last round of grants modelled are those awarded in 2025, there are projects awarded in 2025 which will receive funding over 5 years – until 2030 – and hence the costs to the New Zealand Government extend from 2017-2030).

Source: ACIL Allen

3.1.3 Estimated employment impacts

Employment is closely linked with economic activity and investment, as demand for a firm's goods increases, it can expand its operations and increase levels of capital and, in turn, requirements for labour change. Hence, changes in employment mirror changes in economic output.

A key consideration in estimating employment impacts is how labour markets adjust.[14] Additional demand for labour can be accommodated through 3 main channels:

— increased migration

— higher participation rates and/or average hours worked

— reductions in the unemployment rate.

Within the modelling framework, changes in real wages primarily drive the first 2 mechanisms, while the third reflects the extent to which additional labour demand is absorbed by those previously unemployed. Given the relatively low unemployment rate assumed over the projection period, most of the additional labour supply in the base case (relative to the counterfactual) occurs through modest increases in real wages that encourage greater workforce participation and hours worked.

The analysis does not assume any change in net overseas migration attributable to funded research. Employment impacts presented in this section, therefore, reflect domestic labour market adjustments only.

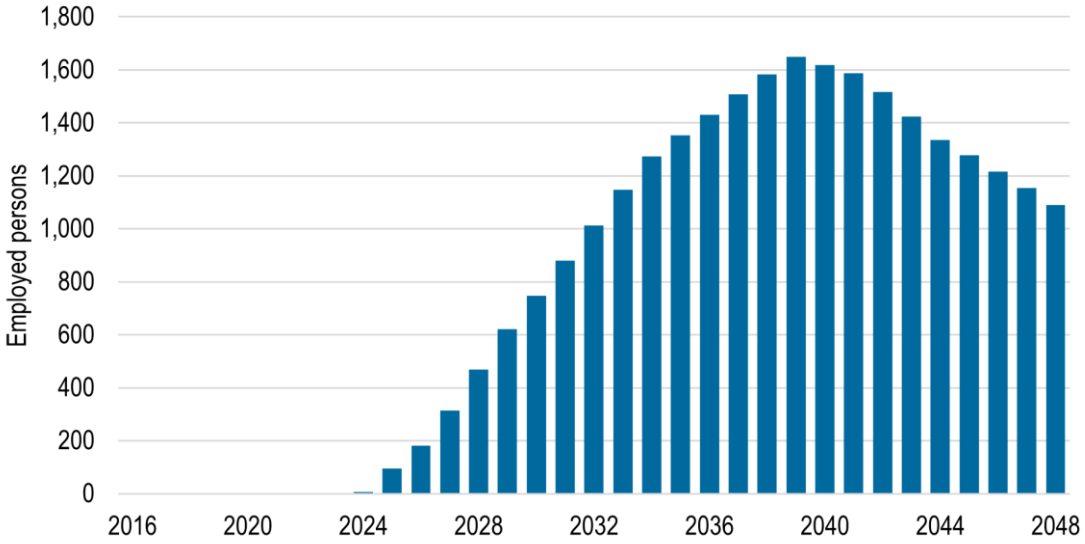
Employment creation

The economic modelling projects that the productivity benefits generated by funded research will result in a net increase in jobs across New Zealand. Indeed, from 2017 to 2048, it is projected that an annual average of 1,019 additional people will be employed in New Zealand as a result of Endeavour-funded research.

[14] As with other CGE models, the standard assumption within *Tasman Global* is that all markets clear (i.e., demand equals supply) at the start and end of each time period, including the labour market. CGE models place explicit limits on the availability of factors and the nature of the constraints can greatly change the magnitude and nature of the results. In contrast, most other tools used to assess economic impacts, including I-O multiplier analysis, do not place constraints on the availability of factors. Consequently, non-CGE methods tend to overestimate the impacts of a project or policy.

Figure 3.4 illustrates the profile of total additional employment in New Zealand under the Fund scenario. As shown in this figure, employment associated with Endeavour-funded grants awarded between 2016 and 2025 is projected to peak in 2039 at around 1,650 additional persons employed.

Figure 3.4 Projected change in total (direct and indirect) employment associated with Endeavour research investments made from 2016 to 2025 (relative to the counterfactual, number of persons)



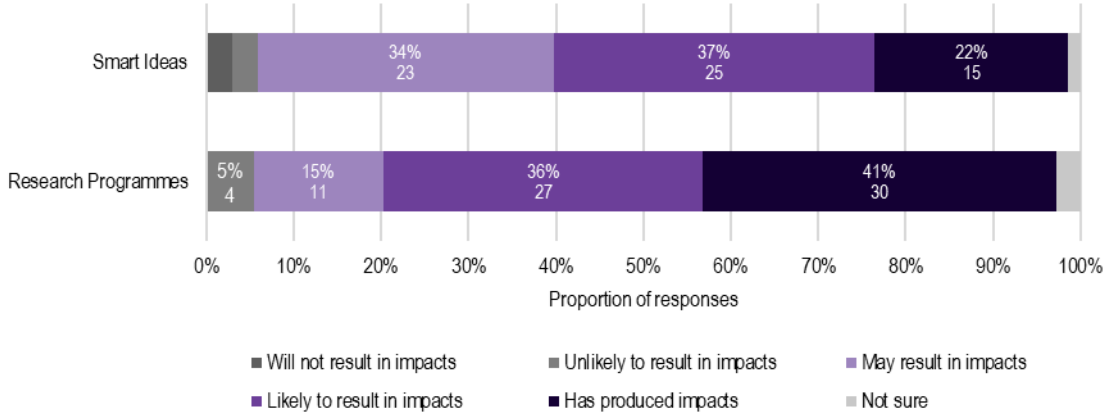
Source: ACIL Allen

3.2 Other economic impacts

Funded research has delivered a range of economic impacts associated with intellectual property (IP) and patents, commercialising and licensing technology, and launching start-up and spin-off companies. Most survey respondents reported that their Research Programmes and Smart Ideas projects were likely to, or had already produced economic and commercial impacts (77% and 59%, respectively and a total of 68%, Figure 3.5).

The broader economic impacts are discussed below. While the Fund does not systematically collect evidence of the economic impacts arising from funded research, this is more commonly collected by the international comparators and represents good practice oversight of research funding (see section 5). There is value in collecting this information to support future assessments of economic impact.

Figure 3.5 Survey result on likelihood of economic/commercial impacts



Note: 124 total respondents (68 Smart Ideas, 74 Research Programmes, 18 across both).

Source: ACIL Allen

Leveraged funding

National funding bodies often require recipients of translational or commercially focused research funding to leverage additional funding sources. Leveraged research funding can be used in several ways, including to reduce the upfront capital costs required to support the research, to validate that the research has been vetted by experts and third parties who are willing to support it, and to close the gap between academic funding for research and the commercial needs of industry partners.

While leveraged funding is not an explicit requirement of Smart Ideas or Research Programmes grants, survey results suggest that researchers have sought additional funding from partners and investors to drive their research impact. The results suggest that 51% of Research Programmes and 43% of Smart Ideas survey respondents have received at least one other non-Fund source of funding during the assessment period. This is comparable to the ARC's NCGP, with between 36% and 53% of survey respondents receiving additional funding sources in parallel with or after ARC funding. Of those Fund survey respondents who secured additional funding, many considered that the Fund was very important in helping them secure funding from the New Zealand central government (51% across all respondents), businesses (47%) and universities (36%). Overall, funded researchers secured a total of $1 billion in additional funding. This equates to $0.43 per $1 invested by the Fund. As expected, this is below ARC's NCGP leveraged $1.20 per $1 invested by the ARC, noting that the ARC has co-contribution requirements for its Linkage Program.

As a point of comparison, Australia's NCGP Linkage Program requires researchers to secure co-contributions to amplify the research funding available and the resulting impact. While different in scope and objectives, the Endeavour Fund broadly seeks to support research between blue sky (supported by the NCGP Discovery Program) and translation (supported by the Linkage Program), and could be expected to deliver results similar to these funding streams. Across NCGP-funded research, researchers secured an average of $1.23 in cash and in-kind contributions per $1 of ARC funding. This highlights an opportunity to further amplify the funding committed by the New Zealand Government by drawing on co-contributions.[15]

[15] ACIL Allen (2023). Impact assessment of ARC-funded research Final technical supplement. Accessed at https://www.arc.gov.au/sites/default/files/2023-08/Impact%20assessment%20of%20ARC-funded%20research%20-%20Technical%20supplement.pdf.

The level of reported leverage is also reflected in the case studies and vignettes. For example, *Fermented Foods* (see Vignette 6) received approximately $9 million in research funding from the Fund to accelerate the natural evolution of microbial strains used to prepare fermented foods. Cash contributions to the project totalled an additional $440,450 from the Alliance Group, Miraka and Fonterra, with in-kind contributions exceeding $1.8 million. This represents an additional 25% of the project value generated from non-government sources. This included an investment of $480,000 by Fonterra to develop new microbial strains for producing cream cheese, thereby shortening the time to market for new products. This funding extended the research scope and enabled the research outputs to be commercially available.

The *Fungal factories* (see section 8) project received approximately $10 million in grant funding and leveraged an additional $437,315 in cash from KiwiNet to support the commercialisation of the research outcomes, as well as significant but unquantified in-kind contributions from the Ferrier Institute and other research organisations. *Future Bees* (see section 9) similarly was funded approximately $7.3 million in grant funding and leveraged an additional $36,800 in cash from Betta Bees Research Ltd and Taylor Pass Honey, and $287,500 as in-kind contributions from Betta Bees Research, and other in-kind support from honey industry parties and research organisations. According to the case study stakeholders consulted by ACIL Allen, these financial and in-kind contributions were critical to progressing the research.

The researchers for the *Augmented Nutrition* (see section 7) project obtained Health Research Council funding to continue the ongoing clinical evaluation of the device's performance characteristics in different clinical settings. This will support commercialisation of the technology.

Commercialisation pathways

Information about commercialisation pathways, including IP, patents, licensing, and start-ups and spin-offs associated with Endeavour-funded research is not systematically collected in a form suitable for analysis, and the survey collected responses from a small number of respondents that identified these outcomes, underestimating the true impacts. However, the case studies and vignettes provide clear examples of successes across these areas.

IP and patents provide a critical pathway for defining the tangible value generated by research outputs, support researchers in securing investment in products and ideas, and grant them the legal rights to commercialise a product, process, or service.

Case studies and vignettes provide examples of IP and patents from funded research. For example, *Fungal factories* (see section 8) research, produced patents in various stages of execution. Patents have been granted in some jurisdictions, including the USA. Four subsequent provisional patent applications have been submitted, relating to the biosynthesis of nodulisporic acids and other groups of bioactive indole diterpenes. *Augmented Nutrition* (see section 7) is treating the results of the research as trade secrets while the technology is further developed. However, the researchers ultimately plan to protect the IP with patents around the algorithm and the device prior to publicly commercialising the technology.

Licensing enables an established company to use the technology in exchange for royalties or fees. This can significantly speed up the path to market. For example, the *Future Bees* case study (see section 9) developed breeding tools for selecting improved bee stock, including genotyping systems enabling low-cost assessment and standard operating procedures for breeders and pollinators. These outputs create industry-wide benefits flowing to multiple companies and the horticulture and honey sectors. There are export opportunities through the export of queen bees and the sale or licensing of germplasm. The innovation in this project included leading-edge bee breeding technology with genetic, genomic and sound-based tests, new ways of monitoring and assessing beehives for breeding purposes, and new technologies for assessing pollination success.

Predator Free NZ (see Vignette 4) developed novel scent, sound and visual lures that improved the effectiveness of invasive species control and monitoring. The most promising outcome was the Manaaki

Whenua – Landcare Research (MWLR) stoat lure, which doubles capture rates and is particularly effective on recalcitrant individuals. There is potential for commercialising and selling the lure in both New Zealand and Europe, providing economic benefits alongside the significant environmental benefits already delivered through improved national biosecurity outcomes.

Start-ups and spin-off companies provide an avenue to develop prototypes to a commercially viable product, generating jobs and investment. Information about the start-ups and spin-offs associated with Endeavour-funded research is not systematically collected in a form suitable for analysis and the survey collected responses from small number of respondents that identified having developed start-ups or spin-offs, which underestimates the true number of start-ups or spin-offs resulting from funded research. The *Fungal factories* case study (see section 8) led to the establishment of Bontia Bio, a synthetic biology start-up company spun out by Wellington UniVentures (the technology transfer office of Victoria University of Wellington) for commercialisation of the nodulisporic acids in animal health and crop protection applications. Bontia Bio has been able to raise pre-seed funding and is focused on animal health therapeutics with additional opportunities in crop protection. The company's first commercial product will be an orally delivered animal health medication for the treatment and prevention of fleas and ticks in companion animals.

The *Personalised Medicine for Movement Disorders* project (see Vignette 1) led to the creation of FormusLabs, a spinout company with multiple commercialisation opportunities from the research. ForumsLabs have engaged multiple orthopaedic companies to explore business opportunities, including Zimmer Orthopaedics and Smith & Nephew. These companies are interested in using the researchers' digital atlas in their pre-operative planning software.

3.3 Examples of excellent research that deliver direct quantifiable impacts

The case studies demonstrate the economic benefits achieved through selected Endeavour-funded research initiatives. These examples build on the broader economy-wide modelling outlined earlier, by showing how specific projects or programmes can generate economic returns that often significantly exceed their funding costs. These case examples align directly with the goals of the Smart Ideas and Research Programmes in fostering job creation and economic expansion.

For this analysis, CBAs were conducted on 4 case studies to assess the net present value (NPV) and benefit-cost ratio (BCR) for individual or grouped projects supported under these funding schemes.

Key CBA findings are outlined in Table 3.3 and detailed in Part 2. Across all cases, NPVs were positive and BCRs exceeded 1, underscoring the value of broad funding for high-quality research by individuals, teams, Public Research Organisations (PROs, formerly Crown Research Organisations), and collaborators spanning various disciplines. These represent only a glimpse of the impacts from Endeavour-funded efforts over the last 10 years, but demonstrate the potential for excellent research to deliver benefits that exceed the cost of grant funding.

Table 3.3 Summary of case study CBAs (NPV and BCR at the 4% discount rate)

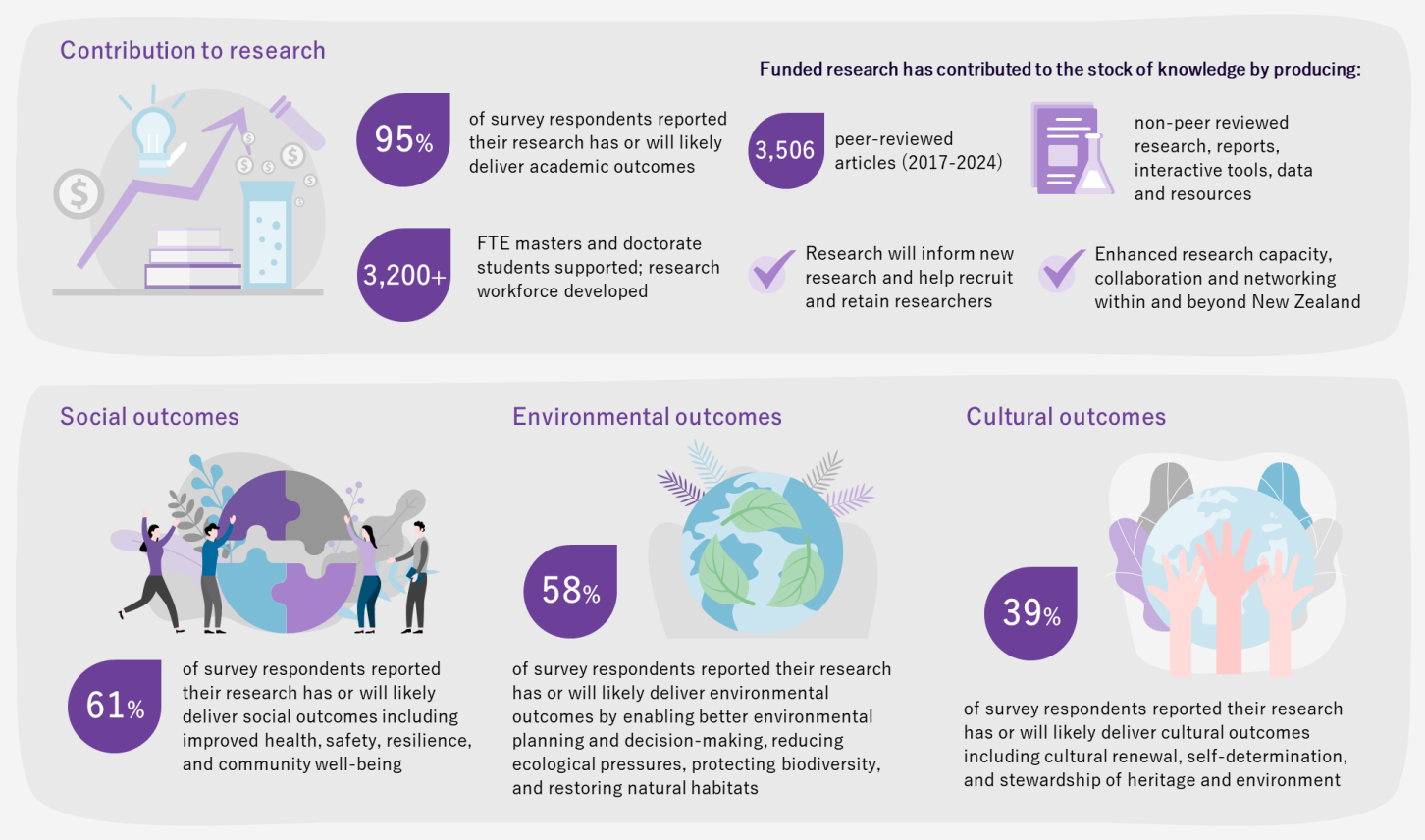
Case study	Grants	Present Value Costs	Present Value Benefits	Estimated NPV (million)	BCR
Augmented nutrition	Smart Ideas	$1.40m	$12.30m	$10.90m	8.83
Fungal Factories	Research Programmes	$13.32m	$72.02m	$58.71m	5.41
Future Bees	Research Programmes	$10.34m	$25.44m	$15.10m	2.46
Multiple sclerosis	Smart Ideas	$1.68m	$71.43m	$69.76m	42.63

Source: ACIL Allen

4 Broader impacts

This section presents the broader impacts of Endeavour-funded research, across research, social, environmental and cultural outcomes. It also considers the Fund's alignment with government priorities.

Finding 2 Broader impacts



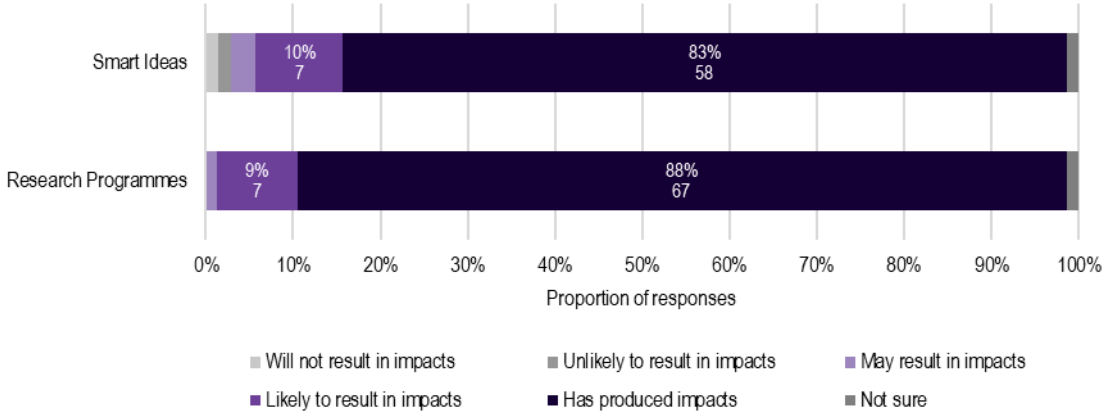
4.1 Contribution to research

Endeavour-funded research has contributed to New Zealand's stock of knowledge, enhanced the capacity and capability of the research system, increased collaboration and networking, and supported research training. These benefits are overviewed below with reference to the survey, vignettes and case studies evidence.

4.1.1 Contribution to the stock of knowledge

Endeavour-funded research has contributed to New Zealand's body of knowledge by generating publications, tools, and community-focused resources. Almost all survey respondents reported that their funded research will likely or has resulted in positive academic impacts, including new research directions, networks, or collaborations (93% for Smart Ideas and 97% for Research Programme, a total of 95% Figure 4.1).

Figure 4.1 Survey result on likelihood of academic impacts



Note: 128 total respondents (70 Smart Ideas, 76 Research Programmes, 18 across both).

Source: ACIL Allen

This is supported by Fund-end-of-grant data, which show that funded research has produced 3,506 peer-reviewed articles between 2017 and 2024. Research Programmes, as expected given their longer funding duration and that more funding is allocated overall to the Research Programmes stream, generated more peer-reviewed publications than Smart Ideas overall (2,818 and 688, respectively). The number of publications likely underestimates the total publications produced by funded research, as not all grant final reports have been completed, and publications may have been made after final reports were submitted.

Overall, projects funded under the Research Programme stream generated an average of 17.2 peer-reviewed papers, while each Smart Ideas project generated 2.0 papers. This lower publication rate likely reflects the overall purpose of Smart Ideas to fund higher-risk projects with a view to catalysing future large-scale research programmes and industry collaboration (as outlined in section 1.1). The higher publication rate across the Research Programme stream is comparable to the ARC's NCGP Discovery Program, which was previously shown to have produced an average of 18.89 papers per project.[16] The Linkage Program, which is more commercially focused, produced 15.60 papers per project. While beyond the scope of this project, a citation impact analysis across these papers would support an understanding of the level of impact delivered.

Final report data from funded researchers, vignettes and case studies all evidence the contribution of funded research to the stock of knowledge. Across the vignettes, funded researchers published a wide range of peer and non-peer reviewed research; produced dedicated project websites to share reports, interactive tools, and resources with end users; distributed newsletters and shared insights on social media; delivered keynote addresses, presentations and panel discussions to share findings with other researchers; provided knowledge and advice to support other research projects and policies nationally (through Government and Māori and Moriori organisations) and internationally (such as the World Health Organization); and generated rich publicly available data and models including a longitudinal survey on ageing, and national model of lake ecosystems.

The case studies have contributed to the stock of knowledge in numerous ways. For example, *Fungal Factories* (see section 8) developed an advanced synthetic biology platform that scales production of hard-to-synthesise natural products. The project generated 6 peer-reviewed papers in elite journals, developed

[16] ACIL Allen (2023). *Impact Assessment of ARC-funded research.* Accessed at: https://www.arc.gov.au/sites/default/files/2023-08/Impact%20assessment%20of%20ARC-funded%20research%20-%20Final%20report_0.pdf

global biomanufacturing knowledge and provided tools for future drug and pesticide discovery, critical for New Zealand's bioeconomy ambitions.

Future Bees (see section 9) advanced apiculture science by creating genomic selection tools tailored to honeybee polyploidy, directly enabling faster genetic gains in disease resistance and pollination efficiency amid Varroa mite-induced collapse of wild populations. The project produced 15 peer-reviewed articles and informed industry standard operating procedures, filling knowledge gaps to sustain New Zealand's $5 billion pollination services, which underpin horticulture exports.

Collectively, this knowledge has been invaluable in enabling the social, environmental and cultural impacts described further below.

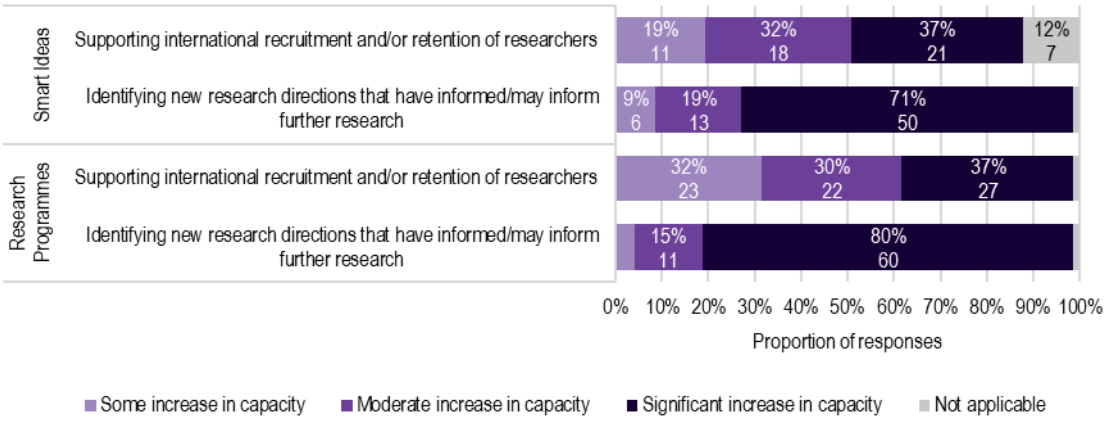
4.1.2 Contribution to research capacity and capability

Endeavour-funded research has provided a pipeline for developing New Zealand's research capacity and capability. Almost all survey respondents reported that their funded research increased New Zealand's broader research potential by identifying new research directions that have informed or may inform further research (99% for both Smart Ideas and Research Programme, Figure 4.2). Most respondents agreed that this increase would be significant (71% for Smart Ideas and 80% for Research Programme).

Further, almost all Smart Ideas and Research Program survey respondents reported that their funded research had significantly increased research capacity by supporting international recruitment and/or retention of researchers. This was significant for 37% of respondents across both funding streams. This is becoming increasingly important given New Zealand's long-standing 'brain drain' challenge of losing highly educated researchers and STEM-skilled workers to Australia and other locations internationally.[17] Indeed, stakeholders reported that capability gains achieved through the Fund can be fragile, with some survey respondents noting that funding gaps and system settings can result in loss of skilled people and momentum.

[17] BBC (2026). *Jacinda Ardern's move to Australia renews spotlight on New Zealand's brain drain problem.* Accessed April 2026 at https://www.bbc.com/news/articles/clyx93597l4o

Figure 4.2 Survey result on increasing research capacity by supporting international recruitment and/or retention of researchers and identifying new research directions



Note: 112 total respondents to the international recruitment question (57 Smart Ideas, 73 Research Programmes, 18 across both). 127 total respondents to the new research directions question (70 Smart Ideas, 75 Research Programmes, 18 across both).

Source: ACIL Allen

Survey responses from Principal Investigators (PIs) emphasised that the Fund built long term research capability, particularly by establishing new research areas, developing expertise across disciplines and enabling follow-on work. Some respondents described the funding as a "backbone" that supported research continuity, helped attract additional grants, and created synergies across multiple projects to collectively deliver stronger impact from the funding investment. Survey results suggest that, among researchers who secured additional funding, it was commonly from the United States of America (20% across all respondents) and New Zealand and Australia (both 16%).

> *"The project has been highly beneficial to the core team as it helped us greatly build our research portfolio in this field and create new networks and research directions."*
>
> *Survey respondent*

Final report data from funded researchers, vignettes and case studies all highlight several benefits for research capacity and capability building by strengthening existing research disciplines and extending the research into new fields and sectors to amplify New Zealand's research impacts and capabilities. For example, the *Fungal Factories* case study (see section 8) demonstrates the international significance of funded research, with the project showcasing New Zealand's ambition in synthetic biology, supporting a growing interest in commercial biomanufacturing, and elevating New Zealand's research on the world stage.

Funded research has also extended New Zealand's research capacity and capability by enabling more (and more effective) collaboration and research training, discussed below.

4.1.3 Increased collaboration and networking

Funded projects encouraged collaboration as a necessary foundation for delivering high-quality and impactful research. The survey demonstrates that funded research has had a strong impact on collaboration and networking (Figure 4.3). Almost all respondents across Smart Ideas and Research Programmes reported an increase in capacity to establish and/or strengthen research networks and to support new research collaborations, both within New Zealand and internationally.

Survey respondents emphasised that the Fund built long-term research capability, particularly by strengthening interdisciplinary teams with universities, Crown Research Institutes (CRIs), industry, iwi, and international partners.

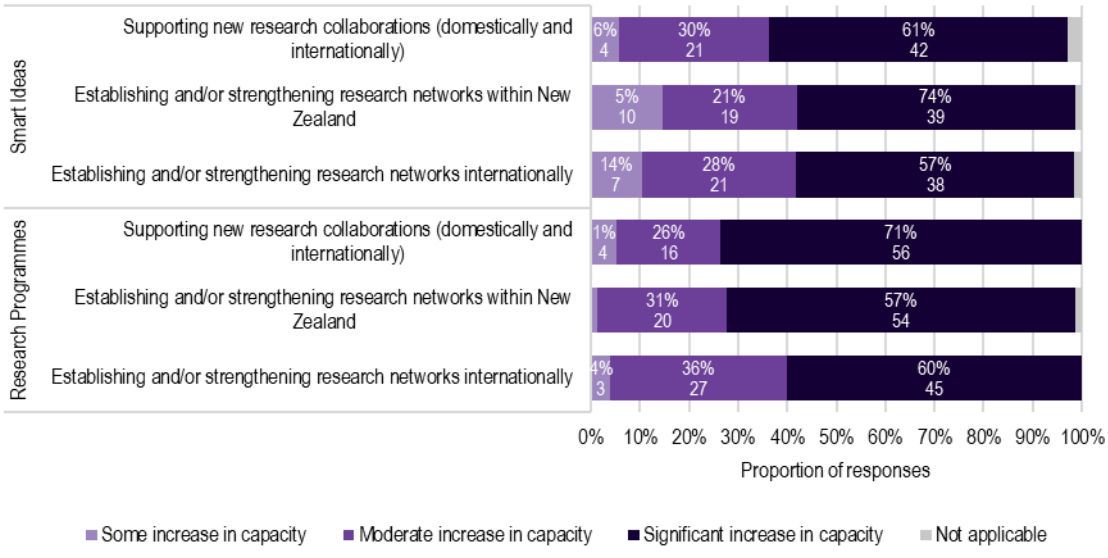
> *"There has been significant upskilling of domestic researchers and the establishment of enduring international collaborations. Dissemination and uptake by regional councils and other stakeholders around New Zealand."*
>
> *Survey respondent*

Survey respondents also highlighted a range of benefits arising from collaboration on funded research projects. Key benefits included the opportunity to broaden the scope and capacity of the collective research team, secure different and complementary skillsets, promote the research internationally, and gain access to specialised facilities.

> *The international research collaborations provide a critical platform for research and researcher development within NZ, and for research on common issues confronting Indigenous communities and populations globally. They also serve as important platforms for successfully seeking research funding from funders within and beyond NZ. An important ancillary benefit has been the development of research capacity and engagement in partnered Māori community organisations -- which has flow-on effects for supporting and growing the much-needed pipeline of young Māori researchers.*
>
> *Survey respondent*

> *Our German collaborations have been important to access laboratory facilities that are not available in NZ. Our German and US collaborations have led to major increases in the impact and awareness of our publications internationally.*
>
> *Survey respondent*

Figure 4.3 Survey results on increased research capacity for collaboration and networking



Note: 127 total respondents to the collaboration and New Zealand research networks questions (69 Smart Ideas, 76 Research Programmes, 18 across both). 124 total respondents to the international research networks question (67 Smart Ideas, 75 Research Programmes, 18 across both).

Source: ACIL Allen

Final report data from funded researchers, vignettes and case studies all demonstrate collaboration and networking across 3 primary fronts.

Researchers partner across **research institutions and universities**. This allows the project to combine a range of disciplines and areas of expertise to ensure there is the capacity and capability to develop the right solution. This approach also widens the scope and scale of the research to deliver more impact across a broader range of disciplines. For example, *Novel Infant Formula* (see Vignette 3) outlines the benefits of research related to algal-based infant formula emulsions for emulating human milk fat. The research required a multidisciplinary team of researchers from AgResearch, Massey University, Monash University, and Copenhagen University, together with researchers from the Fonterra Research and Development Centre, and collaborated with NZ Algae Innovations Ltd. This allowed the project to leverage expertise in food chemistry, food structure, and dairy and microalgae engineering. The *Augmented Nutrition* case study (see section 7) demonstrates the value of working with researchers and clinicians in the Auckland City Hospital to secure access to the hospital's post-operative patients (as potential end users) and to obtain expert feedback on the device and process. *Fungal Factories* (see section 8) leveraged collaboration across 4 universities, a government agency and an industry body. This provided the collective experience and capability needed to develop a novel synthetic biology platform that enables rapid development of companion animal therapeutics.

Partnerships with **industry and government** support the operationalisation of research. Industry and government are often end users of research, and involvement at the start of the research helps ensure the research design aligns with the relevant policy or technical challenge partners face. This ensures that the research goes beyond knowledge to deliver fit-for-purpose products and solutions. Researchers also partner with industry and government when they have responsibility for sharing knowledge and resources more broadly within the community, to support uptake. For example, *Maximising workforce participation for older New Zealanders* (see Vignette 2) provided an evidence-base for policy makers and non-government organisations (such as the World Health Organization) to better understand and design effective policy and supports for New Zealand's ageing population. The *Future Bees* case study (see section 9) demonstrates substantial partnership across academia and industry to amass the expertise required to advance selective breeding and improve beehive productivity. This included expertise in honeybee research, agricultural genetics and genomics, breeding programmes, modelling and quantitative genetics, honeybee artificial insemination, Genotyping by Sequencing, pollination analysis, and cryopreservation of bee sperm.

Researchers partner with **communities** to ensure that end users contribute to the design and development of research and benefit from its outputs. This reduces the friction associated with adopting research outputs and increases the speed of research application and, therefore, impact. For example, *Personalised Medicine for Movement Disorders* (see Vignette 1) demonstrates the value of research in leading to long-term collaborations with the community. The project's collaboration with the Mātai medical imaging institute resulted in the institute extending the research benefits by expanding its imaging services in the Tairāwhiti community. *Predator Free NZ* (see Vignette 4) shows that end users are critical in design and testing, by partnering with end users and communities to test lures for difficult-to-eradicate pests. In examining Fund final reporting, one project focused on the impact of microplastics on biodiversity, ecosystem and human health, and the economy demonstrated strong engagement with end users to influence policy. This included engagement with local councils, transport services, environmental consultants, plastics recyclers and groundwater associations. This provided invaluable advice about local plastic clean up, and inspired ongoing efforts to reduce plastic pollution.

> *Our results confirmed that streamside and inner harbour shoreline litter clean-ups have a significant positive impact by preventing plastic litter migration to the outer harbour and into the wider Hauraki Gulf. Our partners were ecstatic to learn that their on-ground activities make a real difference to the health of the awa and mauri of the Whau, Waitemata Harbour, and the broader Hauraki Gulf. Communicating this has had a significant positive impact on continued community support for future research opportunities.*
>
> *Grant final report*

These partnerships translated academic insights into commercial tools, ensuring that the research and innovation outcomes were sustained long after funding concluded (see section 3).

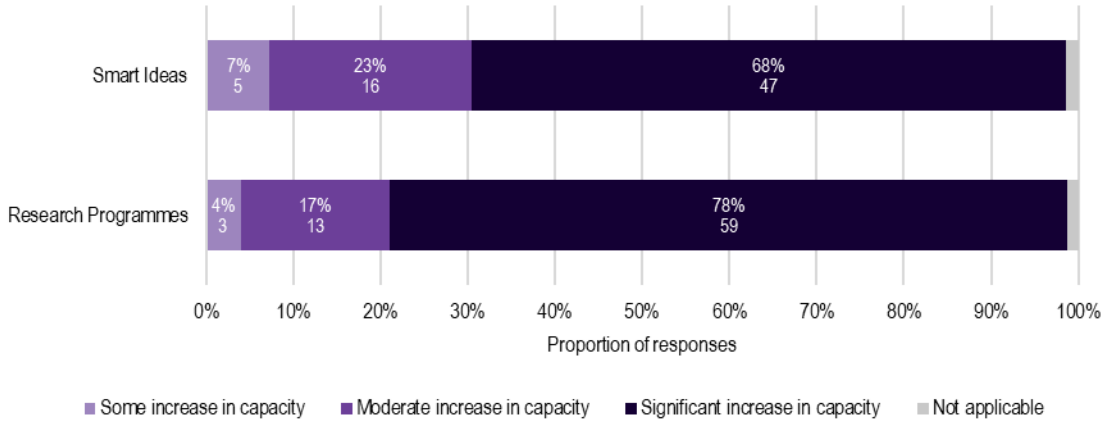
4.1.4 Supporting research training

Endeavour-funded projects have provided a pipeline for workforce development in New Zealand. This includes training students, fostering skills development, and supporting early-career researchers to grow and develop their careers. These capability improvements have supported the development of a more highly skilled workforce, created jobs, enabled knowledge transfer, and fostered innovation.

Fund projects have supported over 3,200[18] FTE students in their masters and doctorate qualifications. This is equivalent to approximately 6 students per funded project. Given their longer duration and stronger research focus, Research Programmes projects were responsible for supporting 80% of these students. In contrast, Smart Ideas was valued for providing opportunities for early career researchers to progress their careers by having a higher risk tolerance and requiring less tenure of experience than Research Programmes. This is because the smaller grant size and more modest complexity of Smart Ideas projects is better suited to leadership opportunities for early career researchers than Research Programmes.

Survey respondents reported that the Fund has generated an increase in highly skilled researchers and/or research graduates (Figure 4.4), with 68% of Smart Ideas and 78% of Research Program respondents reporting a significant increase. Survey responses from PIs also highlighted student training and workforce development as key benefits. It was noted that the CRIs (now known as Public Research Organisations, PROs) would leverage the fund to develop their workforces and build capability.

Figure 4.4 Survey results on increased research capacity in generating highly skilled researchers and/or research graduates



Note: 127 total respondents (69 Smart Ideas, 76 Research Programmes, 18 across both).

Source: ACIL Allen

The vignettes and case studies highlight several benefits for researcher training. The funded projects involved training and mentoring of summer, honours, graduate, postgraduate students and early career researchers, the development of formal research and training opportunities, including a partnership with the Bachelor of Nursing Māori programme for *Personalised Medicine for Movement Disorders* (see Vignette 1), and shared research, training and learning opportunities with communities. *Fermented Foods* (see

[18] Note that the questions about supported students have been reframed in annual and final reports over different reporting periods, and as such, this figure should be regarded as an indication of the number of students supported.

Vignette 6) also resulted in the research team working with the Te Arawa Lakes Trust to develop a Masters of Science level project to use lake models to generate relevant scenarios for the iwi.

Vignette 1 Personalised Medicine for Movement Disorders

Objective

Movement disorders, such as stroke and cerebral palsy, affect individuals in different ways, which creates diagnosis and treatment challenges. Currently, clinicians diagnose and treat movement disorders through qualitative assessment, using knowledge and intuition. The objective of this Smart Ideas project was to change movement disorder diagnosis and treatment, replacing qualitative assessments with quantitative assessments.

The research was undertaken by the University of Auckland, funded under Smart Ideas for 3 years at $999,948 (excl. GST) from 2019. The research was led by Associate Professor Thor Besier from Auckland Bioengineering Institute.



Source: https://profiles.auckland.ac.nz/t-besier

Outputs

The research aimed to deliver personalised medicine for individuals with movement disorders. The researchers developed a wearable sensor that measures muscle activity to quantitatively diagnose patients, as well as a digital atlas of the musculoskeletal system. This includes knowledge on bone shape and muscle volume of a population aged 4 to 99 years old. The web-based tool enables bone models to be predicted from 3D scans. This dataset will be used by clinicians and orthopaedic companies. The researchers also explored and tested options for low-cost scanners to generate 3D models of the musculoskeletal system, for use in healthcare. This makes it possible to generate a 3D full body scans even with a low-cost scanner. This technology is being applied to orthopaedic practices by a spinout company, FormusLabs, developed from the research.

The researchers created a new method to automatically classify patients with neurological disorders. The use of Self Organising Maps (SOMs) will help classify stroke patients based on functional measurements from their gait data.

Outcomes and impacts

The research has provided short-term economic benefits and long-term health benefits to New Zealand. Indirect economic benefits have come from training and mentoring postgraduate students and early career researchers. One early career researcher received the Aotearoa Fellowship within the Auckland Bioengineering Institute, and aim to continue their career with a focus on paediatric orthopaedic biomechanics. A PhD student completed their studies and worked with FormusLabs.

Long term health benefits include improved health outcomes for patients with neurological disorders, which affect one in 3 New Zealanders. The project led to a long-term research collaboration with Mātai medical imaging institute, which has applied for Health Research Council of New Zealand funding to extend their work on imaging the community in Tairāwhiti. A research and training partnership was also established with the Bachelor of Nursing Māori programme, at the Manukau Institute of Technology. This partnership trained 6 nursing tauira through their bioengineering research programme. The knowledge and experience gained from this programme will be shared with the community and other health providers, an important aspect of Te Tiriti.

There are many potential end users of the research outputs. The researchers engaged with multiple orthopaedic companies to explore business opportunities, including FormusLabs, Zimmer Orthopaedics, and Smith & Nephew. These companies are interested in using the researchers' atlas in their pre-operative planning software. ZOZO Inc., a firm that specialises in software development for body measurement systems, was engaged to test and validate the 3D body scanners developed from the project. VICON are interested in adopting the modelling framework in their motion capture business. The Comfort Group are interested in the modelling technology for making mattress and pillow designs for specific body shapes.

The project also created 2 additional commercialisation opportunities. The first would be to commercialise the wearable sensor, which has a broad application across medicine. The second opportunity would be to combine the atlas knowledge and 3D mapping technology and use it to register the anatomy of patients, specifically for orthopaedic use.

4.2 Social impacts

Funded research has contributed to an enhanced evidence base and informed decision-making around public policy and funding. This has delivered substantial social benefits across a range of fields, including enhanced community cohesion and safety, community resilience, more effective risk mitigation, improved quality of life, alleviation of hardship, and improvements to overall public health and wellbeing.

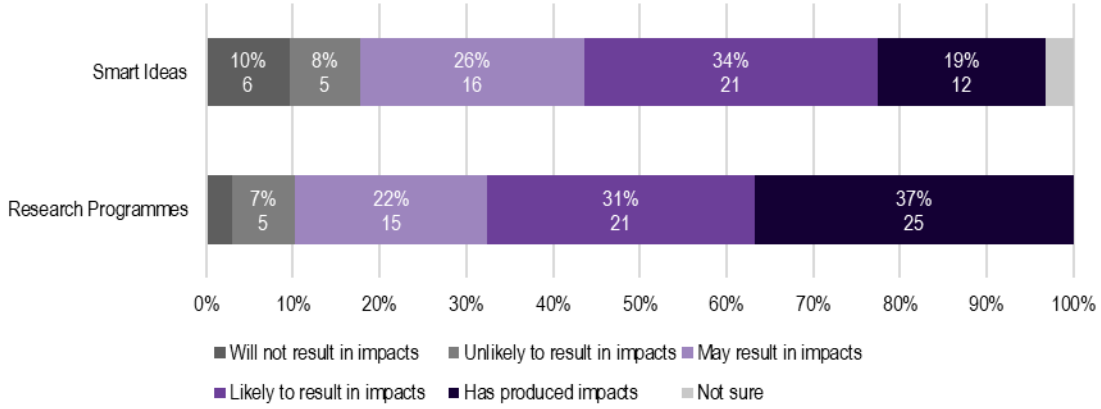
Most survey respondents for Smart Ideas (53%) and Research Programmes (68%) reported that their research is likely to or had produced social impact (a total of 61% across the Fund, Figure 4.5). Only a small proportion (18% and 10%, respectively) considered that social impacts were unlikely to arise from their research.

Survey respondents identified social impacts of improved public outcomes, particularly in health, safety, resilience, and community well-being. Respondents described contributions to public-sector decision-making (including health and infrastructure resilience) and noted the importance of collaboration with community and non-profit partners for the research to be adopted and for benefits to be realised. Several researchers identified equity impacts, particularly in research designed to support Māori and other historically underserved communities (such as those in regional areas).

> *"Our work [in community engagement and urban planning] has had a huge public uptake. Our project in particular became extremely well known among people interested in democratic innovation, long-term issues, and planning. I do hope that the New Zealand policymakers will fund social science research, the impact of which may not be of immediate economic benefit, but may ultimately result in decisions of great social as well as economic importance for the country."*
>
> *Survey respondent*

Grant final reports also highlight the extent of benefits arising from social research. For example, one funded project focused on optimising social services data use to better understand the community's needs, while ensuring privacy and meeting governance standards. This has the potential to shape the way data is stored, shared and accessed, which will improve research and the evaluation of social services data. The research also created Māori data workforce development opportunities and worked to promote Māori data sovereignty.

Figure 4.5 Survey result on the likelihood of social impacts



Note: 112 total respondents (62 Smart Ideas, 68 Research Programmes, 18 across both).

Source: ACIL Allen

Vignettes and case studies from funded projects illustrate the social benefits delivered by funded research for diverse groups across New Zealand.

In particular, across the vignettes, the development of web-based tools, testing of scanners and creation of a 3D model of the musculoskeletal system for *Personalised Medicine for Movement Disorders* (see Vignette 1) will contribute to improved diagnosis, treatment, and health outcomes for patients with neurological disorders, which affect one in 3 New Zealanders. *Maximising workforce participation for older New Zealanders* (see Vignette 2) developed rich longitudinal survey data on ageing for use as an evidence-base for policy makers and non-government organisations (NGOs). This has already been, and will likely continue to be, used to shape national and international policy on ageing, and how governments can best support older people's needs related to housing, neighbourhoods, pandemic responses, and alcohol screening. This has the potential to improve the health and wellbeing of older people, and by extension, enhance community cohesion and resilience.

The *Augmented Nutrition* case study's (see section 7) adaptive enteral feeding pumps directly reduce clinical risks associated with suboptimal nutrition delivery, which can lead to prolonged recovery times and complications following surgery. Through collaborations with Auckland City Hospital, the project conducted trials to ensure patient safety, delivering particular benefits to vulnerable groups, including the elderly and Māori communities. Better nutritional outcomes underpin long-term health equity, addressing disparities where poor feeding contributes to higher morbidity rates in underserved populations.

Novel Infant Formula's (see Vignette 3) research on algal-based infant formula emulsions seeks to replace current emulsions that are derived from palm oil with a reduced nutrient profile and negative infant health impacts. Emulsions derived using microalgae are a healthier alternative to the current approach, with a nutrient profile closer to human milk.

Some sector stakeholders reported a need for more emphasis on funding research that delivers social outcomes, given the critical role of such research in delivering important social impacts. Some considered that these benefits were often undervalued during decisions of research funding allocation.

Vignette 2 Maximising workforce participation for older New Zealanders

Objective

A growing proportion of people in New Zealand aged over 55 are unemployed or underemployed. Many wish to keep working. Maximising their workforce participation would reduce social expenditure, benefit business through retention of skills, and improve health and wellbeing of older people.

This project aimed to identify how government, employers, and workers can support older people's workforce participation. The project received $3,996,874 (ex. GST) over 5 years under Research Programmes from 2017, and extended with the assistance of other, non-MBIE funding to a total of $4,596,406.



Source: Mika, J., Palmer, C., & McLellan, G. (2023). Kaumātua entrepreneurship.

Outputs

The researchers achieved their aims. They gathered evidence through interviews, focus groups and data from the New Zealand Health, Work and Retirement study; and a longitudinal study of people aged 55 years and over on health, work, retirement and housing. The team surveyed older Māori workers, to understand precarious employment experiences for older Māori workers.

Findings were transferred to policy makers, employers, and older workers through:

- Dedicated project website with reports, journal articles, interactive tools, and resources. A total of 735 stakeholders and end-users received newsletters, policy reports, and seminar announcements throughout the project.
- Keynote addresses, presentations, video message and panel discussion as part of the "Ageing in Aotearoa" Symposium.
- Researcher advice to other projects including the Older People, Vulnerability and Multiple Disadvantages project, the Age-related discrimination against older workers research project, and the Senior Enterprise Pilot program.
- Five community engagement events at Dunedin City Libraries, distribution of findings on social media and 27 peer-reviewed publications and 2 books, some of which had official launch events.
- Informing 5 pilot projects by the Office for Seniors focused on people aged over 50 who are considering starting a business. Project funding was provided in the 2022 Budget. The support was predominantly focused on Māori and Pacific peoples.

Outcomes/Impacts

The research developed New Zealand's ageing research capacity, generated rich longitudinal survey data on ageing (an ongoing national information source), and advanced knowledge of the opportunities and challenges of workforce participation for older workers. The longitudinal survey supported new stakeholder relationships and provided an evidence-base for policy makers and non-government organisations (NGOs), and informed research beyond the original scope. For example:

- World Health Organization collaboration on the *Decade of Healthy Aging (2020-2030)*, and support for older adults during the COVID-19 pandemic.
- A policy response guide for older people in relation to the COVID-19 pandemic, *Supporting Older People in Pandemics*.
- Consultation and presentation of results to government, local authorities and NGOs on housing and neighbourhood needs.
- Collaboration with Te Tari Taiwhenua (Department of Internal Affairs, DIA) "exploring whānau attitudes to iwi data collection."
- Discussions with the Labour Pāsifika Caucus on the benefits of making carers leave available for working carers. The team also worked on a draft carers leave policy as a potential private member's bill in 2024.
- Expansion of alcohol related research, including to enhance alcohol screening for older adults, including the Te Whatu Ora National Public Health Service on stage 1 of a multi-stage review of Aotearoa New Zealand low-risk drinking advice.

Vignette 3 Novel Infant Formula

Objective

Current infant formula emulsions are produced using palm oil based emulsions, with a significant environmental impact and negative infant health impacts.[19] The project aimed to create emulsions emulating human milk fat that are tailored to deliver better infant nutrition by combining microalgal oils and dairy phospholipids. This innovative technology is designed to meet the nutritional needs of both infants and the elderly, offering a sustainable alternative to traditional fat sources.

The project received $1 million (ex. GST) from Smart Ideas from 2021 to 2024. Project partners provided $95,000 of in-kind support.



Source: https://ychef.files.bbci.co.uk/1280x720/p0hfhfx2.jpg

Outputs

A project involved a multidisciplinary team of researchers from AgResearch, Massey University, Monash University, and Copenhagen University. The team had expertise in food chemistry, food structure, and dairy and microalgae engineering. The team also collaborated with researchers from the Fonterra Research and Development Centre, and collaborated with NZ Algae Innovations Ltd.

The project screened 5 microalgae strains to determine their ability to biosynthesise an isomer that replicates the structural lipid characteristics of human milk. The project also developed and refined AgResearch's capabilities for advanced microalgae lipid extraction and comprehensive lipid profiling. Different methodologies for extracting lipids from microalgae were tested to determine how best to improve lipid recovery.

The project investigated different emulsification techniques and emulsifiers to develop emulsions properties analogous to those observed in human milk. Emulsions that were stable for at least 4 weeks were developed and used for in-vitro tests of digestibility. The researchers successfully created a lipid solution that closely mimics the nutritional profile of human milk.

The project generated 2 peer-reviewed journal articles, 2 additional peer-reviewed articles that await publication once provisional IP has been granted, 4 non-peer reviewed articles, and a presentation at a major international European conference. The project also trained one post-doctoral researcher.

Outcomes and Impacts

AgResearch intends to apply for patents on the Algaform Nutrition technology developed by this project. Additional funding was secured from KiwiNet, which will be used to further adapt the algae strain to reduce the emulsion production costs associated.

As further work builds on and enhances the emulsion prototype, the researchers anticipate that new IP may be developed and incorporated into the provisional patent application for the emulsion prototype or form the basis for a new provisional patent application. Once IP protection has been obtained, commercialisation will follow. This will involve seeking a partner for microalgae production, and negotiations with interested parties on licensing the Algaform Nutrition IP to a large dairy or food ingredient company. This is expected to create a faster route to market. Initial discussions have been held with New Zealand dairy companies Fonterra and Danone, with plans to also pursue potential international partners.

The research has demonstrated a more sustainable alternative to the current palm oil based emulsions and is expected to reduce the environmental impact of producing infant formula emulsions.

[19] Padial-Jaudenes, M., Castanys-Munoz, E., Ramirez, M., & Lasekan, J. (2020). Physiological impact of palm olein or palm oil in infant formulas: a review of clinical evidence. *Nutrients*, *12*(12), 3676.
Meijaard, E., Brooks, T. M., Carlson, K. M., Slade, E. M., Garcia-Ulloa, J., Gaveau, D. L., ... & Sheil, D. (2020). The environmental impacts of palm oil in context. *Nature plants*, *6*(12), 1418-1426.

4.3 Environmental impact

Funded projects have generated substantial environmental impact by providing an evidence base and developing systems for enhanced environmental planning and decision-making. This has resulted in innovations to reduce ecological pressures, protect biodiversity and restore habitats; support long-term ecosystem health; provide sustainable alternatives to resource-intensive practices; and enhance climate resilience across New Zealand.

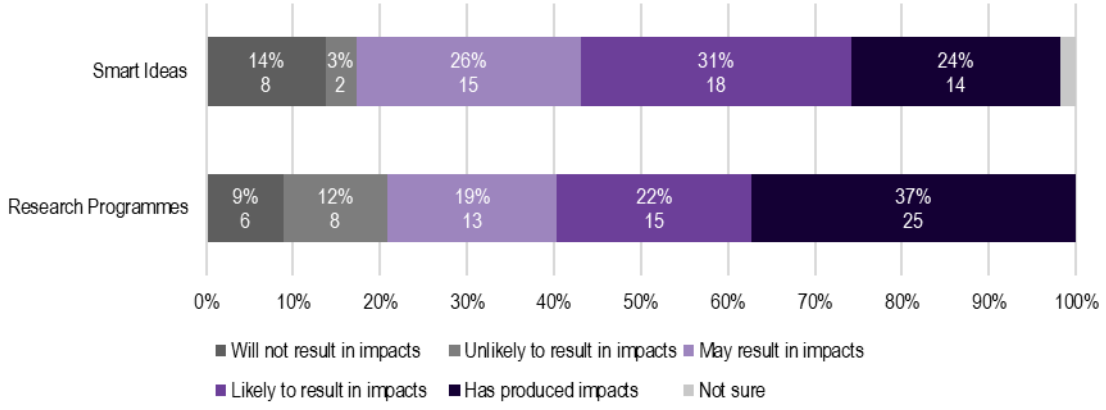
Over half of respondents for both Smart Ideas and Research Programmes indicated that environmental impacts have been or are likely to be achieved by their research (55% for Smart Ideas and 59% for Research Programme, a total of 58% across the Fund, Figure 4.6). Fewer respondents reported that their research would be unlikely to generate environmental impact (17% for Smart Ideas and 21% for Research Programmes).

Environmental impacts were a major theme across free text survey responses. Several respondents linked their work directly to conservation and environmental management outcomes, particularly in climate-related planning, biodiversity, pest control, river and coastal management, and sustainability. A common message was that environmental research generates high public value even when it does not produce immediate revenue or commercialisation outcomes.

> *"I consider the Endeavour Fund to have been an essential resource for conducting environmental research."*
>
> *Survey respondent*

Grant final reports also highlight the extent of benefits arising from environmental research. One example focused on *Transitioning Taranaki to a Volcanic Future - He Maunga Piua*, noting that the Taranaki volcano has an almost 50% chance of erupting over the next 50 years. The research generated discoveries into the fundamental science underpinning magmatic and volcanic processes, which were incorporated into new hazard maps, and response and recovery plans at regional and national levels to grow the resilience of local communities.

Figure 4.6 Survey result on the likelihood of environmental impacts



Note: 107 total respondents (58 Smart Ideas, 67 Research Programmes, 18 across both).

Source: ACIL Allen

Sector stakeholders described significant environmental contributions from Endeavour-funded research. While some considered that the Fund overly prioritised primary industries, they noted that work in these areas often delivered practical tools. However, many found it challenging to disentangle Endeavour-specific

effects from sector-wide efforts funded through other mechanisms. Attribution of research benefits has been explored in more detail in the case studies (see Part II).

These vignettes and case studies provide concrete examples of how research outputs translate into measurable conservation benefits.

Lake ecosystems models (see Vignette 5) have advanced the capacity to manage and restore New Zealand's lake ecosystems. The research has expanded the predictive capacity from 24 lakes to over 3,800 water bodies. This has involved forecasting trajectories under the National Policy Statement for Freshwater Management (NPS-FM) 2020. The model also provides a tool for developing regional plans to ensure the health and sustainability of lakes across New Zealand. By guiding nutrient load reductions, they enable restoration of wetlands and habitats. This work is essential for maintaining freshwater ecosystems amid intensifying agricultural and climate pressures.

The *Predator Free NZ* initiative (see Vignette 4) developed novel lures that were more generally attractive to invasive predators, while others targeted recalcitrant individuals that refused to engage with trap or bait stations using standard lures. These novel lures doubled the capture rates of stoats, which devastate native birds and reptiles. These lures provide a way to effectively control populations. The framework developed through the project has now been incorporated into the Māori Predator Free 2050 strategy, with these tools supporting iwi frameworks like Maranga Ake Ai. This project has delivered significant environmental benefits by improving national biosecurity outcomes through the provision of new tools to control predator species and prevent further extinctions in biodiversity hotspots.

Novel Infant Formula (see Vignette 3) outlines the benefits of research on algal-based infant formula emulsions. Emulsions derived from microalgae are a more sustainable alternative to current palm oil use, with a lower environmental footprint for deforestation, biodiversity loss, and climate change.

Future Bees (see section 9) demonstrates how the research findings can be applied to better control invasive and damaging social wasps and eradicate invasive hornets, both of which destroy bee hives. This has a severe impact on food production capacity, honey production and clover pollination, which supports pasture viability and the grazing livestock industry.

Vignette 4 Predator Free NZ

Objectives

A predator-free New Zealand is one of the nation's top priorities for protecting native biodiversity. Complete eradication of this programme's target predators – possums, stoats and rats – is prohibitively expensive using current pest control methods because these always leave some survivors, referred to as 'the last 5%'.

The 5-year Predator Free New Zealand project aimed to identify cost-effective methods to eliminate the remaining individuals. The project proposed a novel approach to identify candidate sensory lures based on '4F' motivations (feeding, fighting, fleeing, and fornication), which are primary animal motivations. It sought to understand the behavioural characteristics contributing to some individual pests surviving control, and how these survival behaviours can be manipulated and overcome using novel cues.



Source: https://theowp.org/reports/predator-free-2050-an-achievable-goal/

The project received $7.5 million (excl. GST) under Research Programmes over 5 years from 2019, with the final tasks completed by September 2024.

Outputs

Initial behavioural studies showed that individuals exhibit a wide spectrum of behaviour, from 'bold' to 'recalcitrant', which determines their susceptibility to toxins and traps. Recalcitrant animals exhibit behaviour that currently prevents their eradication.

The researchers subsequently developed novel scent, sound and visual lures that improved the effectiveness of invasive species control and monitoring. Some lures were attractive to invasive predators more generally, while others targeted recalcitrant individuals that refused to engage with standard trap or bait stations.

The researchers worked with iwi and imi partners to support application of the new lures, including developing and testing a pest control framework that combines the research findings with Mātauranga, namely Māori and Moriori-based approaches to pest control. This framework was incorporated into the Māori Predator Free 2050 strategy, Maranga Ake Ai, for use by other groups. Field trials were used to quantify improvements in the efficacy of the predator control methods.

Outcomes/Impacts

Outcomes were transferred through engaging with iwi, and through public meetings. Adoption of the most promising lures and approaches was facilitated by stakeholder engagement in the field trials with New Zealand's major pest control agencies, such as the Department of Conservation, Operational Solutions for Primary Industry, the Ministry for Primary Industries, Predator Free 2050 Ltd, and several NEXT Foundation-funded projects.

The project delivered significant environmental benefits by contributing to improved national biosecurity outcomes through the provision of new tools for the control of predator species and providing practical advice on how to best manage control operations.

Potential economic benefits may arise through the commercialisation of the Manaaki Whenua – Landcare Research stoat lure. The lure doubles capture rates and is particularly effective on recalcitrant individuals, making the product particularly useful for managing stoat populations. There is potential for sales of the lure in both New Zealand and Europe.

Researchers engaged with 12 end users in the final project year: advising 3 on the use of lures and eradication of pest species, aiding 2 to develop whakapapa and pest control frameworks, and supporting 2 summer students to undertake sound lure trials. Other end users provided survivor possums and received lures and findings. Researchers also worked with end users on an eradication program and community-driven testing of the lures.

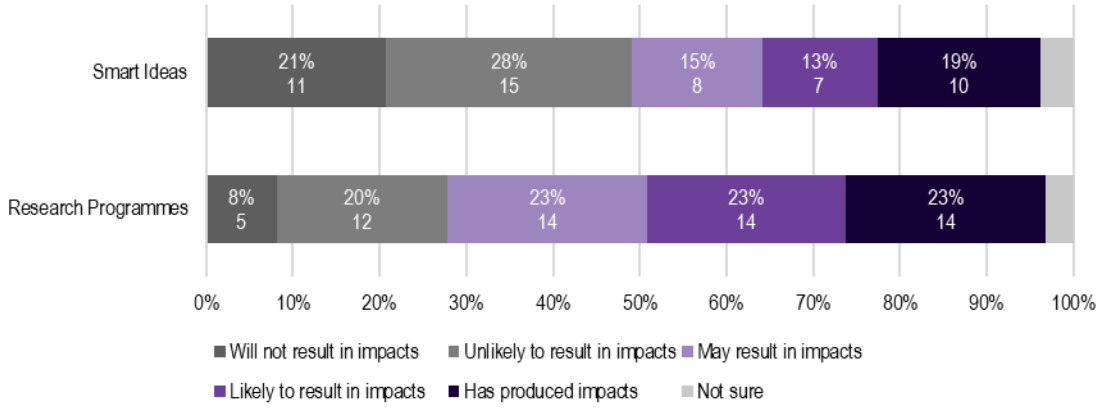
4.4 Cultural impacts

Funded projects have affirmed and integrated Māori knowledge systems, and supported cultural healing, self-determination, and the co-development of resources that respect tikanga and mātauranga Māori. These contributions strengthen community identity, preserve heritage practices, and enable iwi-led governance in research.

Fewer researchers reported that their research will likely or has produced cultural impacts compared with social, environmental and economic impacts. This was under a quarter for Smart Ideas (23%, Figure 4.7) and approximately half (46%) of Research Programme-funded respondents (a total of 39% across the Fund).

Cultural impacts were prominent among free text survey responses, with many respondents describing meaningful engagement with Māori communities and the integration of mātauranga Māori into research design and delivery. Responses referred to partnerships with iwi, hapū, Mana Whenua, and Māori organisations, including co-development approaches and wānanga. Some projects also described explicit Māori capability-building outcomes, including training and employment of Māori researchers and data scientists. Overall, the cultural impact narrative was one of stronger relationships, more culturally grounded research practice, and research outputs that better reflect Māori priorities.

Figure 4.7 Survey result on the likelihood of cultural impacts



Note: 96 total respondents (53 Smart Ideas, 61 Research Programmes, 18 across both).

Source: ACIL Allen

Smart Ideas survey respondents reported that their funded research is aligned with Vision Mātauranga to various extents (Figure 4.8). The most aligned area was *recognising Māori as important partners in science and innovation; both as inter-generational guardians of significant natural resources and indigenous knowledge, and owners and managers of commercial assets,* where 89% of respondents reported that their research was aligned. Survey results for Research Programme-funded research show that funded research was broadly more aligned with Vision Mātauranga than Smart Ideas-funded research. The area most aligned was *building the capability of Māori individuals, businesses, incorporations, rūnanga, trusts, iwi, hapū, and marae to engage with science and innovation,* where 98% of respondents reported alignment with their research.

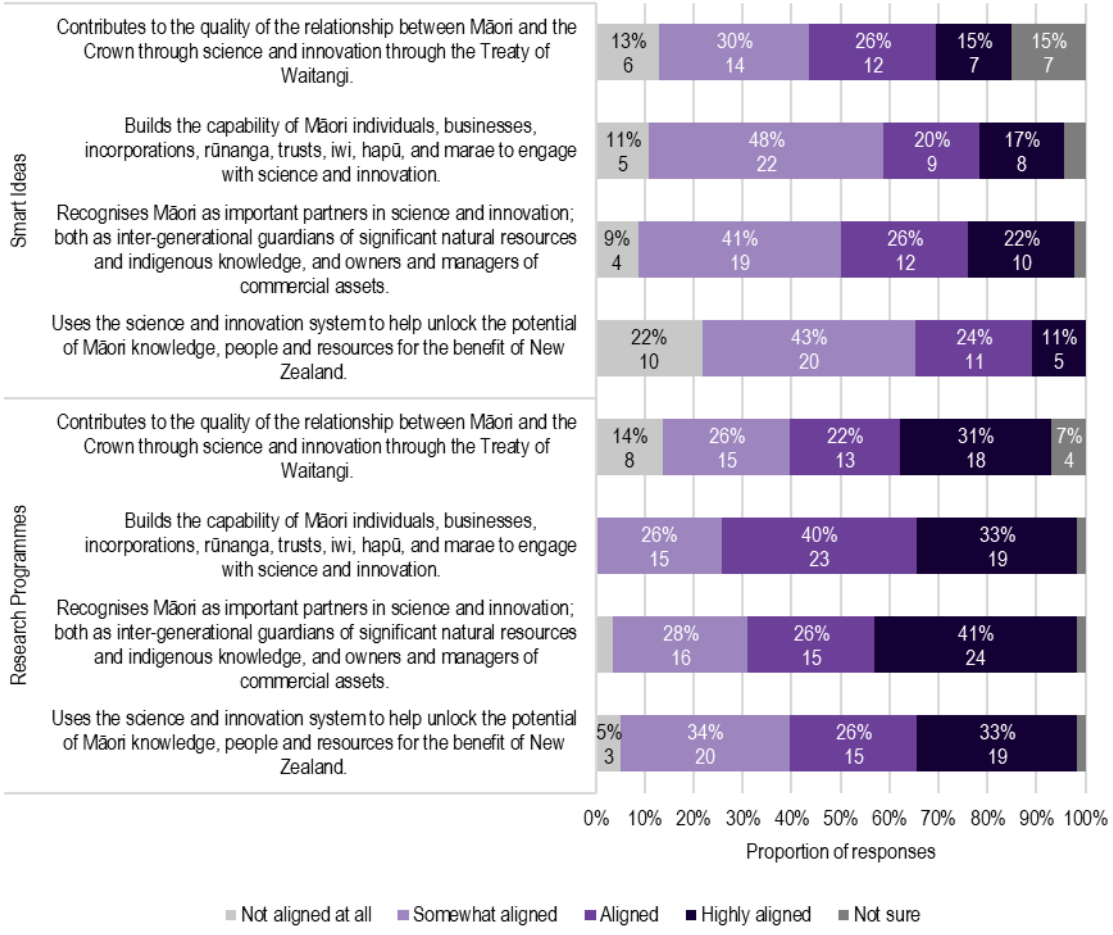
> *"The project gave effect to Vision Mātauranga through its focus on co-designing an evidence-informed Kaupapa Māori model for participatory child protection practice, grounded in and accountable to Māori perspectives and priorities, and aimed at enhancing the developmental, social and cultural well-being of care-involved Māori children. Our research design was informed by Kaupapa Māori methodologies*

and by Oranga Mokopuna, a decolonial child well-being model based in Te Ao Māori and collective indigenous rights. Māori scholars and service providers were key members of the research team, and all elements of the project, including key project outputs, were developed and delivered in partnership with Māori partners and end users."

Survey respondent

Grant final reports also highlight cultural benefits arising from research. For example, one project examined the over-representation of Māori and Pacific peoples among people with low literacy and/or numeracy skills. This has significant economic and social costs (unemployment, poverty, physical and mental wellbeing, lower social and political attachment), at individual-, family/whānau-, community- and national-levels. The research provided new insights into barriers and enablers for building skills and resilience, and is informing a major policy review and reform within the Ministry of Education aimed at improving public service delivery.[20]

Figure 4.8 Survey results on the alignment of Smart Ideas- and Research Programmes-funded research with Vision Mātauranga



Note: 91 total respondents (46 Smart Ideas, 58 Research Programmes, 13 across both).

Source: ACIL Allen

Vignettes and case studies demonstrate how researchers have worked closely with indigenous communities to ensure representation in the project design and outcomes, and the embedding of Vision Mātauranga principles to foster reconciliation and cultural revitalisation.

[20] The team established a website for a summary of their aims, partners, and links to research outputs. See https://nzpri.aut.ac.nz/research/low-literacy-and-numeracy-research

Future Bees (see section 9) directly empowered iwi partners such as Ngāti Pōtou Miere and Tai Tokerau Honey through an industry advisory group, providing genomic tools and elite queen bee stocks for sustainable beekeeping. This collaboration integrates Māori viewpoints on environmental guardianship, enabling early-adopter advantages for Māori businesses while upholding tikanga in commercial operations. Such advancements ensure cultural continuity in apiculture, a practice deeply tied to traditional resource management and community sustenance.

Fermented Foods (see Vignette 6) established a Wakatū Te Tau Ihu indigenous microbe biobank, preserving native strains for applications like kawakawa leaf fermentation. This resource directly supports the development of products for gut health and cognition, and secures valued intellectual property rooted in Māori knowledge. By advancing culturally relevant biomanufacturing, the project fosters revitalisation of traditional food practices and contributes to iwi economic sovereignty.

The *Lake ecosystems models* vignette incorporates mahinga kai indicators, empowering iwi to assess water quality for culturally significant species such as kōura (freshwater crayfish) and kākahi (freshwater mussel). This enables informed participation in resource governance through development of community-aligned action plans, and is examined in more detail in Vignette 5.

The *Predator Free NZ* initiative (see Vignette 4) researchers worked with iwi and imi partners to develop and test a pest control framework that combines the research findings with Mātauranga-based approaches and support iwi frameworks like Maranga Ake Ai.

Sector stakeholders valued the embedding of Māori perspectives, which has strengthened over time and produced positive outcomes when integrated thoughtfully throughout the research pipeline. There is growing support across the sector for Māori-led co-research roles, with a view to enhancing the impacts of research on the New Zealand environment and health.

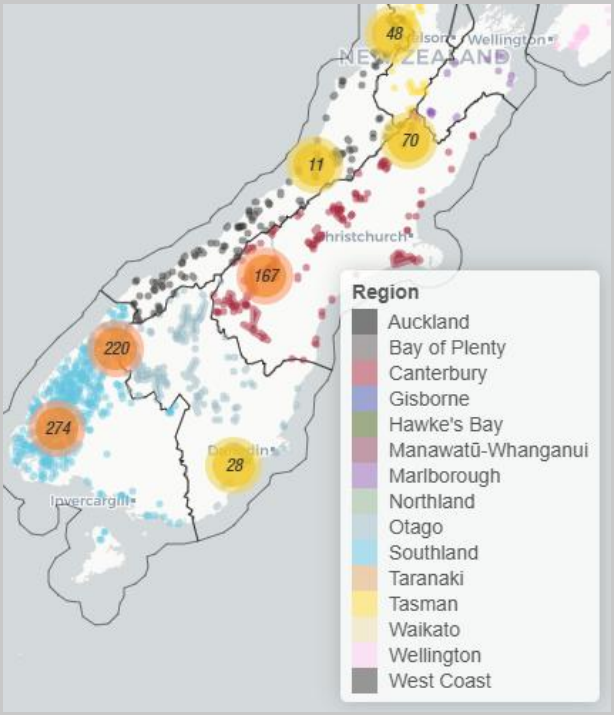
Vignette 5 Lake ecosystems models

Objective

Government policy for managing lake ecosystems requires setting limits on the flow of nutrients and sediment into catchments. Such limits may need to be specified for as many as half of New Zealand's 3,820 lakes. Ecosystem models are indispensable tools for identifying these limits by enabling simulation of a lake's responses to various management activities. To date, these models have only been applied to a small subset of New Zealand lakes, as they require considerable time and expert knowledge to configure for each specific lake.

This project aimed to develop a robust, transparent, and open-access platform to make lake ecosystem models more accessible to lake managers and iwi. Model access will enable greater community engagement and more informed policy development.

The project received $1m (excl. GST) under Smart Ideas over 3 years, from October 2021 to September 2024.



Source: https://limnotrack.shinyapps.io/LERNZmp/

Outputs

The researchers built a model that simulates lake ecosystem dynamics in New Zealand using national-scale datasets on climate, lake and catchment characteristics, lake depth, and satellite remote sensing. They derived a lake classification that can predict unobserved water quality using multiple biogeographical variables derived from Fire and Emergency New Zealand and satellite remote sensing data. The model's predictions for water quality indicators, such as Secchi depth (a measure of water clarity or transparency) and chlorophyll concentrations are as good as, or better than, existing single variable and statistical models.

The model incorporates aspects of mahinga kai, converting vertical water temperature and dissolved oxygen concentrations to mahinga kai habitat quality indicators. This allows users to investigate the effects of water quality changes on habitat availability for culturally significant species such as kōura (freshwater crayfish) and kākahi (freshwater mussel).

The platform also enables synoptic (current weather) simulations for most New Zealand lakes, allowing for comprehensive assessment of the change required to achieve water quality objectives, such as Trophic Level Index targets (which characterises lake health based on nutrient amounts and algal growth), adhering to national bottom lines outlined in the National Policy Statement for Freshwater Management 2020, and improving habitat quality metrics related to mahinga kai health.

Outcomes/Impacts

The research has advanced the capacity to manage and, where necessary, restore New Zealand's lake ecosystems by providing access to a highly flexible and comprehensive modelling platform. The project has expanded the scope of lake ecosystem modelling in New Zealand from 24 lakes to a potential 3,820 lakes nationwide.

The platform integrates key environmental values, including water quality, ecological health, and mahinga kai (Te Mana o te Wai), as mandated by the National Policy Statement for Freshwater Management 2020. The platform can also integrate and analyse the best available data, including historical time series and data from similar lakes, offering an unprecedented opportunity to study the long-term changes in lakes and predict future trajectories with limited information. The model enables users to balance lake use with environmental health and develop community-aligned action plans. It allows for rapid updates, and can accept input from diverse sources. The model provides a crucial tool to support regional plans that integrate economic use with lake health and sustainability. Researchers reported that 23 organisations would use the platform. The research team will work with the Te Arawa Lakes Trust to develop a Master of Science level project to use lake models to generate relevant scenarios for the iwi.

4.5 Alignment with government priorities

Alignment of funded research with government priorities has been considered at both the strategic and project levels.

Application at a strategic level

The *National Statement of Science and Innovation 2015-2025* (NSSI) reaffirmed the New Zealand Government's focus on supporting excellent research to deliver impact in areas of future value, growth or critical need.[21] It established a vision for a science system with a more visible and measurable contribution to New Zealand's productivity and wellbeing, with a focus on knowledge-intensive sectors and enhanced economy-wide productivity.

MBIE's 3-year Investment Plans operationalise the NSSI by outlining the government's 'Investment Signals', the primary directive for the types of research government is willing to fund. The Minister of Science, Innovation and Technology issues a formal Gazette Notice for each funding round, mandating the Science Board to allocate funds in accordance with the Investment Signals outlined in the Investment Plan and Gazette Notices.[22] Proposals must demonstrate research excellence and the potential for impact in areas of future value, growth or critical need.[23] In addition, MBIE requires that all proposals consider how they may give effect to Vision Mātauranga, which focuses on "the various ways in which Māori communities, knowledge and resources may be enabled, mobilised, and empowered in research, science and innovation".[24] This aligns research with the government's specific Treaty of Waitangi obligations and social equity priorities.

The 2017-2020 Investment Plan identified Investment Signals related to excellent and high-impact research, higher risk and longer term impact horizons, leveraging of investment and knowledge, maintaining a balance on economic (70% of the Fund's value), environmental (25%) and social (5%) objectives, and giving greater effect to Vision Mātauranga.[25] The 2019-2021 Investment Plan identified similar Investment Signals, with reference to broader Government policies and strategies, a shift toward supporting knowledge-intensive industries and supporting the transition to a low-emissions economy.[26]

The Fund complements the government's policies and strategies, including its investment in mission-led science through the Strategic Science Investment Fund, National Science Challenges, and Health Research Council, as well as across the New Zealand Government, including the past Business Growth Agenda, current Going for Growth Agendas, He kai kei aku ringa (which aims to grow the Māori economic sector and deliver prosperity to Māori), the Tertiary Education Strategy, and the New Zealand Biodiversity and Biosecurity Strategies.[27] This approach aligns with international good practice for priority-driven, mission-led research funding (see section 5.2).

[21] New Zealand Government (2015). *National Statement of Science Investment 2015–2025*. New Zealand Government.
[22] For example, New Zealand Government (2019). *Endeavour Fund 2020 Investment Round*. Accessed March 2025: https://gazette.govt.nz/notice/id/2019-go3220.
[23] Ministry of Business, Innovation and Employment (2024). Op. cit.
[24] Ministry of Business, Innovation and Employment (2019). *Endeavour Fund 2020 Assessment Guidelines*. New Zealand Government.
[25] Ministry of Business, Innovation and Employment (2017). *Endeavour Fund Investment Plan 2017-2020*. New Zealand Government.
[26] Ministry of Business, Innovation and Employment (2018). *Endeavour Fund Investment Plan 2019-2021*. New Zealand Government.
[27] Ministry of Business, Innovation and Employment (2017). Op. cit.

4.5.1 Application at a project level

While Investment Plans guide funding allocation, the Fund does not collect data on the extent to which projects align with government priorities at the project level, either at the application stage (which sets the intent for the research design), or at the final reporting stage (which captures insights on completed research). Stakeholders consulted for the impact assessment had difficulty attributing the impacts of funded research to government priorities. The lag between policy cycles and research timelines also creates limitations in attributing research outcomes to specific policy objectives. This is a common challenge observed across international funding agencies.

Researchers and stakeholders valued the mission-led approach to the Fund, with Government setting the agenda for key principles that funded research must deliver on. The Fund also provided sufficient flexibility so that funded research could pursue different topics and research paths as they emerged, as long as they aligned with the overall principles and original aims.

Researchers and stakeholders presented mixed perspectives on the requirement to align with government priorities. Some reported that the requirement was helpful in supporting researchers to consider and plan for how their research may generate commercial and economic benefits, noting that they would not have done so otherwise. Conversely, some reported that researchers were shaping their proposals to reflect the relevant priorities without an intent to deliver on these.

The survey results show high alignment between Smart Ideas- and Research Programmes-funded projects and government priories (Figure 4.9), notably on promoting innovation, science and technology (97% and 96%, respectively), improving educational achievement and growing skills (80% and 83%, respectively), strengthening trade and investment (each 74%), and giving effect to Vision Mātauranga (70% and 81%, respectively).

Survey responses from researchers showed project alignment with government priorities at both national and regional levels, especially in conservation, resilience, health and safety, and environmental management. Many respondents cited direct policy relevance through work with agencies (e.g. Ministry for the Environment, Accident Compensation Corporation, WorkSafe, councils, and infrastructure agencies), and some described their research as already informing policy implementation or operational practice. There were examples of alignment with named government initiatives, such as Predator Free 2050 (see Vignette 4) and with local/regional planning priorities.

Grant final reports also highlight several instances where research is having direct impacts on industry policy and practices. For example, a funded project focused on salmon mortality found that environmental data, fish performance measures and/or behavioural signals can provide early warning of mortality events. The project developed an early warning decision support model that industry uses to guide decision-making towards improved outcomes. The research estimates that a conservative 10-20% survival improvement would generate millions in savings industry annually.

The case studies also highlight important evidence of excellent research delivering on Government priorities. The *Fungal factories* case study (see section 8) has supported Government's intent to advance new technologies by advancing synthetic biology and New Zealand's bioeconomy, and supporting a more sustainable manufacturing base for the nation's agricultural sector. *Future Bees* (see section 9) demonstrates the value of research in expanding high value exports, aligned with the Government's Business Growth Agenda export targets.

Conversely, a few survey respondents reported that policy uptake can be uneven, or that valuable research is not always adequately recognised in policy processes. This highlights an opportunity for some researchers to better understand the needs of end users in designing their research, and how to effectively communicate the research findings in a way that encourages uptake from end users.

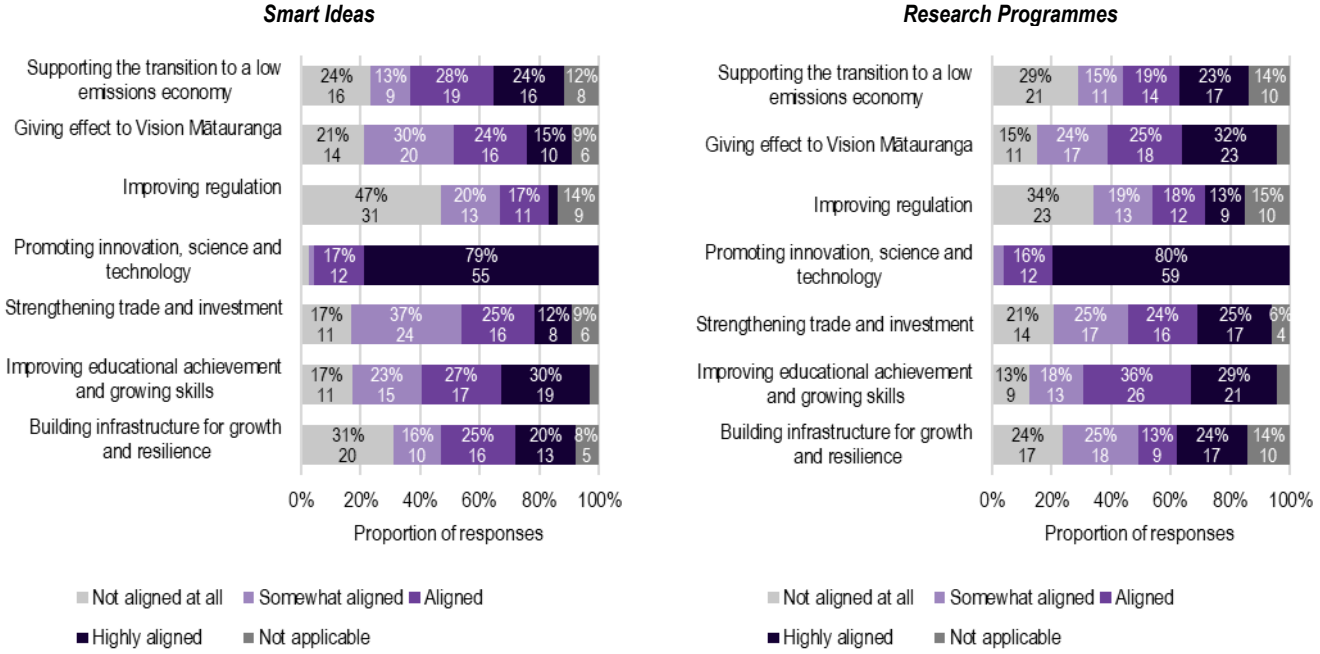
"The research has informed national efforts to ensure that the participatory commitments embodied in the United Nations Convention on the Rights of the Child (to which NZ is a signatory) are fully realised, including in the landmark Royal Commission into Abuse in Care, and in the work of Oranga Tamaraki and related government agencies more generally."

Survey respondent

"Our research has been mentioned and often extensively cited in various government (as well as other high level) reports, especially those focusing on the state of democracy, infrastructure and urban planning, community engagement and similar issues. See for example Future for Local Government report from 2024, Deloitte State of the State 2023, Long Term Insights Briefing 2022, Public Service Commission Te Kawa Mataaho advice on deliberative processes."

Survey respondent

Figure 4.9 Survey results on alignment with government priorities of Smart Ideas- and Research Programmes-funded research



Note: 124 total respondents to the transition to a low emissions economy question (68 Smart Ideas, 73 Research Programmes, 17 across both).

120 total respondents to the Vision Mātauranga question (66 Smart Ideas, 72 Research Programmes, 18 across both).

117 total respondents to the improving regulation question (66 Smart Ideas, 67 Research Programmes, 16 across both).

126 total respondents to the promoting innovation, science and technology question (70 Smart Ideas, 74 Research Programmes, 18 across both).

117 total respondents to the trade and investment question (65 Smart Ideas, 68 Research Programmes, 16 across both).

119 total respondents to the education question (64 Smart Ideas respondents, 72 Research Programmes, 17 across both).

118 total respondents to the infrastructure question (64 Smart Ideas, 71 Research Programmes, 17 across both).

Source: ACIL Allen

4.5.2 Contribution to public policy

As part of this assessment, ACIL Allen sought evidence of the contribution Endeavour-Funded research makes to public policy outcomes and decisions. Unfortunately, the information required to undertake this assessment systematically is not regularly collected for the Fund in a format that is suitable for analysis.

However, in the course of this impact assessment, we have uncovered examples of the research's contribution to government decisions and to the various ministries that sponsor/partner with PIs. These include the Ministry for the Environment, Accident Compensation Corporation, WorkSafe, local and regional councils, and infrastructure agencies, as noted in the section above. The survey responses and selected vignettes also demonstrate isolated instances of these contributions to New Zealand's policy process.

To support future evaluations, it would be ideal for the Fund's managers to collect information relating to these types of contributions. This information could include the number of submissions to inquiries, expert witnesses and evidence reports, and the level of participation in national policy-making forums by leading researchers. Such information, when coupled with impact tracing and case study techniques, can provide conceptually robust empirical evidence of the Fund's future contribution to government decision-making and public policy. That said, consultations with fund managers in other countries highlighted that New Zealand was not alone in lacking the empirical evidence to undertake this type of impact analysis systematically.

Vignette 6 Fermented Foods

Objective

Fermentation is a widely accepted form of low-impact processing that adds value to food, extends shelf-life, and creates differentiation and novelty in otherwise narrow ranges of flavours (such as lactic acid bacteria used to prepare yoghurt). Microbes perform functions that would otherwise require more additives such as salt, stabilisers or preservatives to be used.

This project aimed to accelerate the natural evolution of microbial strains used to prepare fermented foods via non-GMO strain improvement and phenomics techniques. This enabled rapid development of strains for use in New Zealand's dairy, meat, and indigenous horticulture sectors to develop new fermented foods with novel flavours, enhanced textures, safer storage, and reduced reliance on additives like salt or preservatives. The team also examined sensory preferences of recent Chinese immigrants in New Zealand, and compared these to China-based consumers' preferences, to guide product development for major export markets.

The project received $8,990,909 (excl. GST) in Research Programmes funding from 2017-2022. Cash contributions totalling $440,450 were provided by the Alliance Group, Miraka and Fonterra. Total in-kind contributions were $1,834,250.



Source: https://www.agresearch.co.nz/our-research/fermentation-for-future-food-systems-what-are-the-opportunities-for-new-zealand/

Outcomes

A multidisciplinary team from AgResearch, Massey University, and Callaghan Innovation collaborated with partners including Fonterra, Miraka, Alliance Group, and Spring Sheep Dairy. They evolved pre-approved commercial strains, developed hardware and in vitro assays for sweet, bitter, umami, and kokumi (mouthfeel/creaminess) taste responses, and validated these against consumer panels with strong correlation. The project delivered new pilot-scale drinking yoghurts with new sensory profiles. The technology developed for the project was used to develop a number of new strains, which were transferred to private firms (6 to Fonterra for the production of yoghurt drinks/cream cheese and 3 to Yili for producing probiotics). In addition a Wakatū (Te Tau Ihu) project created an indigenous microbe biobank with metadata that could be used for kawakawa leaf fermentation to alter texture, chemistry, and bitterness.

The project generated 12 peer-reviewed publications, 10 non-peer-reviewed articles, and 7 conference proceedings.

Outcomes and Impacts

The evolved strains developed under contract for Yili were shown to reduce probiotic fermentation times from 72 hours to under 32 hours. This could lead to cost savings, improved pH control, and lower yeast/mould risks. These strains have been banked and if used are expected to shorten probiotic market timelines from 10 to 5 years. Adopting these new stains could help grow New Zealand's $7.5 billion annual dairy exports to China. Fonterra leased the rapid screening technology developed by the project to validate growth media in 3 months (compared to 18 previously). Fonterra invested $480,000 in developing new microbial strains for producing cream cheese. These strains have been banked and, if used, will shorten the time to market of new products.

Follow-on funding has exceeded $1 million, including $304,000 from Four Good Foods for lamb charcuterie and $225,000 for a Fonterra-funded PhD candidate studying how to use the perceptions of recent Chinese immigrants on dairy products as proxies for consumers in mainland China. Fonterra since adopted immigrant proxy testing of its products.

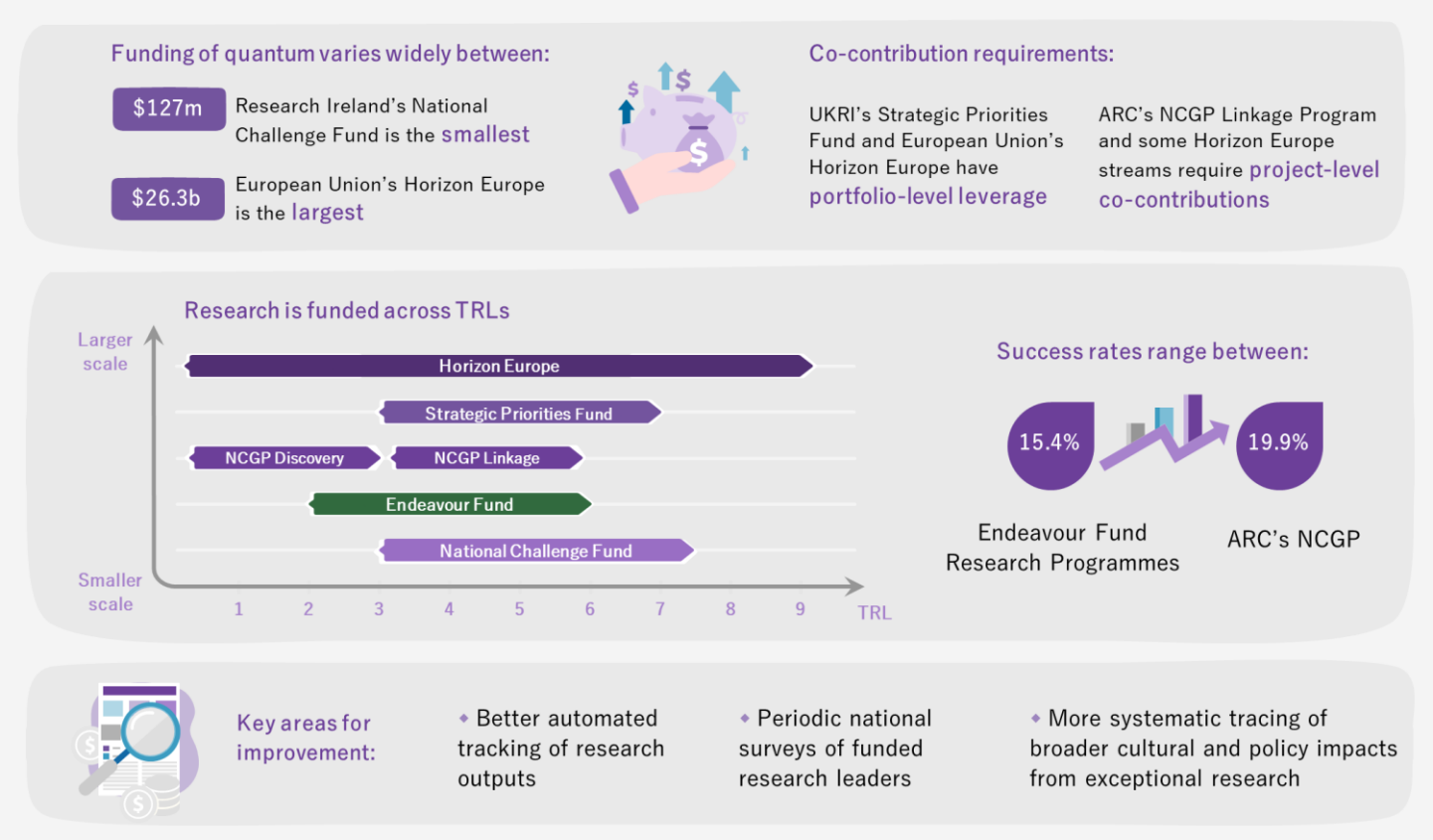
Wakatū benefits included intellectual property from Te Tau Ihu microbes for gut health and cognition products, with broader potential in ruminant methane reduction.

The project trained 2 Masters students, 3 PhDs, and 8 postdocs. The International Science Advisory Panel commended the complete research and development pathway from discovery to market-driven optimisation, as enhancing New Zealand's competitiveness in food fermentation.

5 International comparisons

This section provides a comparative analysis of international funds as a comparison exercise for the Endeavour Fund.

Finding 3 International comparisons



5.1 Comparison funds

This study has compared the Endeavour Fund with 4 research funding initiatives: the Australian Research Council's (ARC) National Competitive Grants Program (NCGP), UK Research and Innovation's (UKRI) Strategic Priorities Fund (SPF), Horizon Europe, and Research Ireland's National Challenge Fund. While it is acknowledged that each fund operates at a very different scale (budget envelope) from the Endeavour Fund, they offer insights into the:

- structure and logic of the funding, including the focus of the research, the required co-contributions and success rates
- outcomes and impacts from funded research, including alignment with government priorities and involvement of end-users
- monitoring, analysing and reporting on outcomes and impacts.

These insights have been generated through a combination of consultation with stakeholder representatives from the funds and publicly available information.

5.1.1 National Competitive Grants Program (Australia)

The NCGP, administered by the ARC, is the largest and primary source of funding for non-medical research in Australia.

The NCGP allocates research grant funding via a competitive peer review process through the Discovery Program and the Linkage Program. The Discovery Program funds blue-sky research in Australia, while the Linkage Program focuses on collaborative research that links universities, industry and other research users.

Under these programs, the ARC funds a range of complementary schemes. The aim is to support researchers at different stages of their careers, build Australia's research capability, expand and enhance research networks and collaborations, and develop centres of excellence.

The intended outcome of the Programs is to contribute to the growth of Australia's research and innovation capacity, which generates new knowledge and results in the development of new technologies, products and ideas, the creation of jobs, economic growth, and an enhanced quality of life in Australia.

5.1.2 Strategic Priorities Fund (United Kingdom)

UK Research and Innovation (UKRI) is the UK's largest public investor in research and innovation, using taxpayers' money to support a dynamic portfolio that delivers economic, social, environmental and cultural benefits. Established in April 2018, its mission is to advance understanding of people and the world around us, and to translate this understanding into benefits for society, the economy, and the environment.

UKRI brings together 9 councils: the 7 disciplinary research councils, Research England (which funds research and knowledge exchange in English higher education institutions) and Innovate UK, the UK's innovation agency. These councils fund and support universities, research organisations, businesses, NHS bodies, charities, NGOs and other institutions across the research and innovation system.

UKRI is a non-departmental public body sponsored by the Department for Science, Innovation and Technology (DSIT). HM Treasury allocates funding to DSIT through spending reviews and budgets, and DSIT, in turn, allocates funding to UKRI, sometimes with ringfenced budget categories or other conditions attached. UKRI works with its councils and strategy committees to recommend how this funding should be distributed across the 9 councils and collective programmes, aligning investments with the ambitions in the UKRI Strategy 2022–2027 and with wider government priorities.

UKRI allocates this funding through a mix of project grants, institutional block grants, infrastructure and skills investments, challenge-led and innovation funding, and international partnerships. Co-investment from industry and other partners provides additional funding at the project and programme level.

The most appropriate UKRI investment mechanism to compare to the Endeavour Fund is the Strategic Priorities Fund (SPF). The SPF, valued at £830m (NZ$1.9 billion), aims to align UKRI funding with government research priorities, while also responding to emerging strategic opportunities.[28] The SPF has 3 overarching objectives:

1. to drive an increase in multi-disciplinary and inter-disciplinary research and innovation (MIDRI)
2. to ensure UKRI's investments link up effectively with government priorities
3. to respond to strategic priorities or opportunities.

SPF has funded 34 programmes across 2 waves, supporting 767 individual projects, of which 578 were research grants. An interim evaluation of the SPF was completed in 2023, with the final evaluation expected in 2026.

[28] UKRI (2024) *Strategic Priorities Fund.* Accessed at: https://www.ukri.org/what-we-do/strategic-priorities-fund/

5.1.3 Horizon Europe (European Union)

Horizon Europe is the European Union's (EU) research and innovation funding program running from 2021-27. It is the 9th European framework for research and innovation funding and follows its predecessor program, Horizon 2020. Horizon Europe was created to:

— strengthen the EU's knowledge base through frontier research
— spur breakthrough innovation and support the development and demonstration of innovative solutions
— restore industrial leadership and strategic autonomy.[29]

The initiative fosters a collaborative and cross-sectoral European research and innovation ecosystem by funding grants to university researchers and collaborative projects with the scientific community, government and industry. It supports projects with a high economic, social and scientific impact. Additionally, Horizon Europe engages in co-funding partnerships with private and public organisations as part of an integrated approach to addressing major issues.[30]

The EU funds Horizon Europe to the value of approximately €95 billion (NZ$187 billion).[31] Funding is guided by an overarching strategic framework centred around 3 vertical pillars, with funds allocated from 2021-2024 being:[32]

— Excellent Science (€11.1 billion, NZ$21.8 billion)
— Global Challenges and European Industrial Competitiveness (€25.4 billion, NZ$50 billion)
— Innovative Europe (€4.9 billion, NZ9.6 billion)

5.1.4 National Challenge Fund (Ireland)

Research Ireland, established in 2023, provides competitive funding for research and innovation on a national scale. It aims to fund and champion excellent research and innovation across all disciplines of the economy, society, culture, and environment. Research Ireland's key objectives include promoting world-class standards in research quality, supporting researchers across all fields, and strengthening ties between the research system and government, enterprise, NGOs, and society. It manages a substantial portfolio of public investments.

In consultation with representatives from Research Ireland, the National Challenge Fund was identified as a useful point of comparison to the Endeavour Fund due to its direct focus on national priorities. The National Challenge Fund is a €65 million (NZ$127 million) research programme funded under Ireland's National Recovery and Resilience Plan via the EU's Recovery and Resilience Facility. It supports over 90 research teams tackling key challenges in Green Transition and Digital Transformation through 8 challenge streams.

Teams in the National Challenge receive up to €250,000 (~NZ$490k) for 18 months to develop ideas, with select projects advancing to €500,000 (~NZ$980k) follow-on funding and prizes of €1–2 million (NZ$2–3.9 million). The fund emphasises collaboration with government, enterprise, academia, and societal stakeholders to deliver solutions aligned with national priorities.

Challenges include:[33]

— Future Food Systems

[29] European Commission (2021). *Horizon Europe strategic plan 2021-2024*. Accessed December 2022: https://op.europa.eu/en/web/eu-law-and-publications/publication-detail/-/publication/3c6ffd74-8ac3-11eb-b85c-01aa75ed71a1.
[30] Ibid.
[31] European Commission. *Horizon Europe.* Accessed at: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en
[32] European Commission (2025). *Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024)*. Accessed at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025SC0110
[33] Science Foundation Ireland. *The National Challenge Fund.* Accessed at: https://www.sfi.ie/challenges/National-Challenge-Fund/

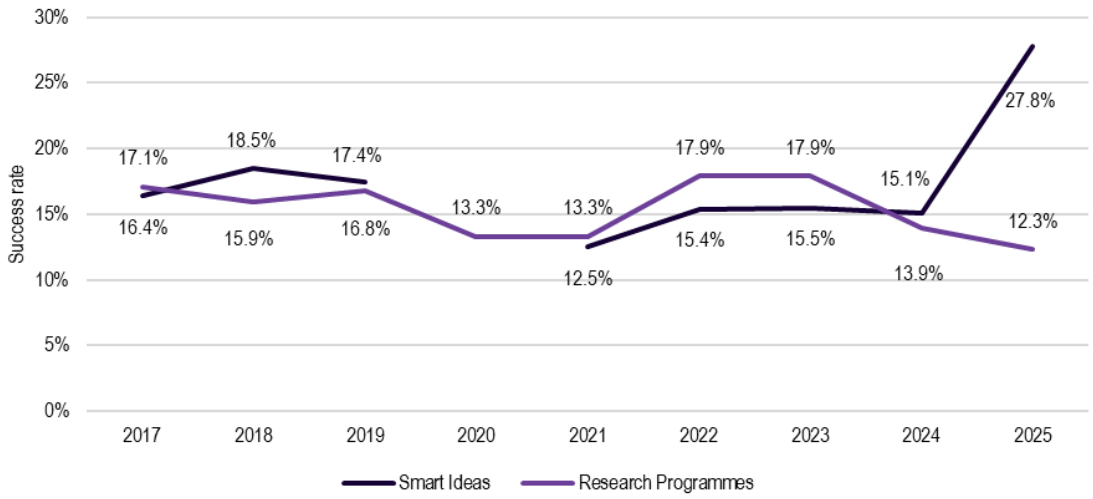
- Sustainable Communities (enhancing Ireland's capabilities in crisis prediction and response)
- Digital reliance
- Energy innovation
- Healthy environment for all
- Our Tech (enhancing the connections between government, communities and people)
- 2050 Challenge (achieving climate neutrality by 2050)
- Future Digital Challenge (creating and applying disruptive digital technologies that will contribute to national recovery and resilience).

5.2 Design and key features

5.2.1 Success rates

While the number and scale of applications for each of the comparison funds differ substantially, the success rates for Smart Ideas and Research Programmes are similar to those of other international competitive grant funds. The average success rates for the 2 Endeavour mechanisms between 2017-2025 were 17.3% and 15.4% respectively, and have remained relatively stable over time (see Figure 5.1). It should be noted that success rates for Smart Ideas in 2025 increased primarily due to the introduction of an organisational cap on the number of applications.

Figure 5.1 Success rates by Endeavour Fund investment mechanisms



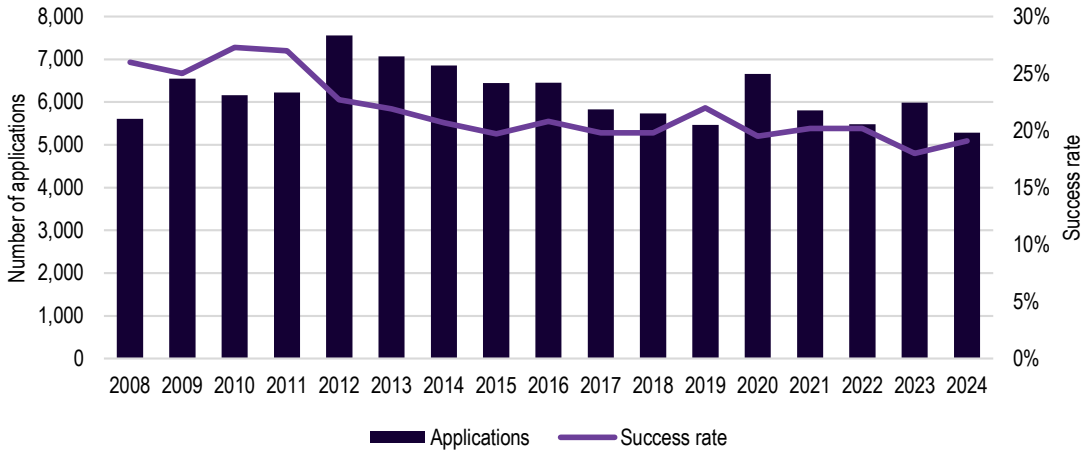
Note: No Smart Ideas funding was allocated in 2020 due to COVID

Source: MBIE. 2025 Endeavour Fund – End of year wrap-up. Accessed at: https://www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/endeavour-fund

Success rates for the ARC's NCGP are viewable via an interactive online dashboard.[34] Between 2002 and 2024, overall success rates were 23.9% (20.5% and 38.5% for Discovery and Linkage programs, respectively). However, a more useful comparison for the Endeavour Fund would be success rates between 2016 and 2025. During this time period, overall success rates fell to 19.5%. The figure below shows the general decline in success rates from 2006 to 2024.

[34] ARC. *NCGP Trends: Success Rates.* Accessed at: https://www.arc.gov.au/ncgp-trends-success-rates

Figure 5.2 Success rates for the ARC's NCGP



Source: ARC. Accessed at: https://www.arc.gov.au/ncgp-trends-success-rates

Success rates vary across UKRI programmes, and UKRI does not publish a single success rate for individual funds such as SPF. However, UKRI publishes organisation-wide data on applications and awards. According to UKRI Investment and Outputs Data 2015-16 to 2024-25, the number of applications assessed has doubled over the past decade, from 15,436 in 2017-18 to 30,550 in 2024-25. Over the same period, the number of grants awarded remained broadly stable, at around 5,500-5,700 per year. Because applications increased much faster than awards, the overall award rate by number fell from 36% in 2017-18 to 19% in 2024-25. In value terms, requested funding rose more quickly than available funding: the award rate by value fell from 46% to 25% over the same period.[35]

In Europe, between 2021 and January 2025, a total of 76,423 applicants had applied to Horizon, with an average success rate of 16.4%.[36] The success rates differed by pillar: Excellent Science (15.5%), Global Challenges and European Industrial Competitiveness (19.7%), and Innovative Europe (11.0%).

Research Ireland has not yet published success rates for applications to the National Challenge Fund. However, in its previous iteration as Science Fund Ireland, overall success rates were approximately 25%.

Overall, Endeavour Fund success rates are in line with international benchmarks, with trends across jurisdictions suggesting that declining success rates are largely driven by increasing application pressure rather than reductions in funding.

5.2.2 Targeting of funding

International comparator funds support a spectrum of basic and applied research, tailored to the priorities of individual programmes or streams. Funding is organised around 3 core themes: targeted basic research (researcher-led), targeted applied research (end-user-led), and mission-based research (government priority-led). While some countries allocate funding distinctly across these themes, others integrate basic with mission-based research or applied with mission-based research.

Smart Ideas funds early-stage, high-risk research ideas proposed by researchers, supporting targeted basic research. Proposals must show potential to address New Zealand's future value, growth or critical-needs. Research Programmes support ambitious, multi-year research designed to transform New Zealand's future

[35] UKRI (2025). UKRI investment and outputs data 2015 to 2025. Accessed at: https://www.ukri.org/publications/ukri-investment-and-outputs-data-2015-to-2025/

[36] European Commission (2025). *Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024)*. Accessed at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52025SC0110

in defined areas of future value, growth or critical need, which embeds mission-based, government-priority direction. Within those programmes, teams undertake a mix of discovery and applied work.

The NCGP explicitly aims to support fundamental and applied research, backing the discovery of new ideas and the advancement of knowledge alongside more practical work, thus spanning targeted basic and applied research. It also encourages collaboration with industry and other end-users and is being reviewed to ensure alignment with national priorities and visible returns on public investment.

Table 5.1 Targeting of funding comparison

Metric	Targeted basic research (researcher-led)	Mission-based research (Government priority-led)	Targeted applied research (end-user led)
Smart Ideas	✓	✓	
Research Programmes	✓	✓	
NCGP	✓	✓	
Horizon Europe - Excellent Science	✓		
Horizon Europe – Global Challenges and European Industrial Competitiveness		✓	✓
Horizon Europe – Innovative Europe		✓	✓
SPF	✓	✓	
Ireland National Challenge Fund	✓	✓	✓

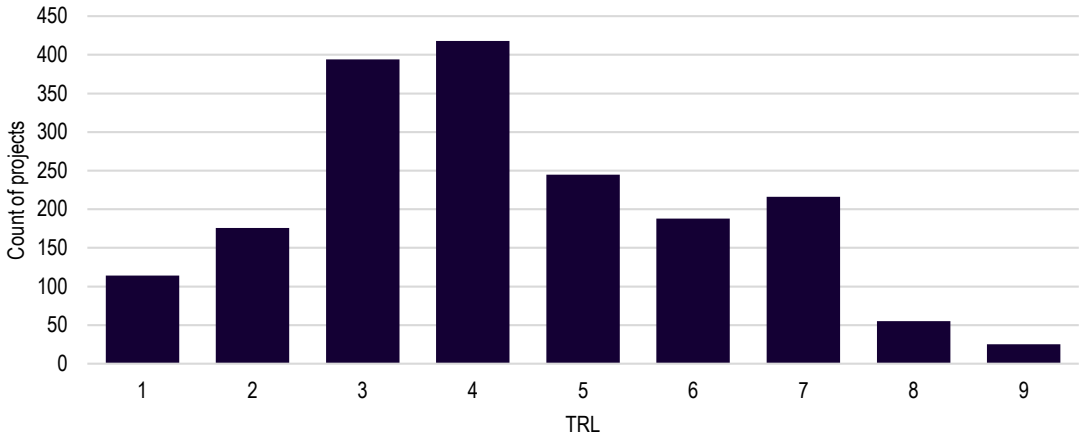
Source: ACIL Allen

The Excellent Science pillar of Horizon Europe focuses on high-gain/high-risk research led by individual investigators and research organisations, which makes it a predominantly researcher-led basic research instrument. Horizon's Global Challenges & European Industrial Competitiveness Pillar is mission-based, it being structured around thematic "clusters" and Missions that directly support EU policy goals. Innovative Europe is explicitly oriented toward deploying solutions, supporting start-ups and SMEs, and strengthening Europe's competitiveness, targeting applied, end-user-led research and innovation rather than curiosity-driven basic research.

The SPF is designed to ensure research and innovation investment "links up effectively with government research and innovation priorities" and responds to strategic priorities, making it inherently mission-based. Similarly, the National Challenge Fund is organised as a set of thematic "Challenges" aligned with Ireland's green transition and digital transformation goals.

Horizon Europe's 3 pillars each target a different range of Technology Readiness Levels (TRLs), with Excellent Science focusing on lower TRLs, Global Challenges and European Industrial Competitiveness on all TRLs and Innovative Europe on higher-end TRLs. While there is no direct comparison with the total of Endeavour-funded research, the figure below shows a spread of Horizon's funded projects by TRL.

Figure 5.3 Current TRL of Horizon Europe projects as reported by beneficiaries (1,807 projects)



Source: European Commission. Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024)

The Endeavour Fund therefore broadly aligns with international approaches, combining elements of targeted basic and mission-based research, while comparator funds tend to distribute these functions across separate programmes or pillars.

5.2.3 Co-contributions

While Previous MBIE-supported contestable funding mechanisms, like the Partnership Scheme and National Science Challenges, included targets for stakeholder contributions, the Endeavour Fund does not specify a mandatory cash or in-kind co-contribution from research users or industry partners. This is in contrast to several of the international comparators considered here. Endeavour proposals must be led by New Zealand research organisations and designed so that most of the benefits in new knowledge accrue outside the host organisation, which means many Endeavour-funded projects are developed and delivered in partnership with external stakeholders who contribute expertise, data, infrastructure or other in-kind support.

Applicants to the NCGP's Linkage Program must include Partner Organisations that provide cash and/or in-kind contributions to the project. The total contributions from Partner Organisations (combining cash and in-kind support) must equal or exceed the funding requested from the ARC.[37] This is a markedly higher minimum leverage requirement than under Endeavour, especially where projects are industry-heavy.

Co-contributions to the UK's SPF programmes are primarily in the form of strategic and in-kind commitments from government departments, Public Sector Research Establishments (PSREs), industry and third-sector partners. In-kind commitments include participation in governance, provision of data, infrastructure access, and staff time. Although direct cash from partners is often limited, SPF awards usually sit within programmes that attract substantial in-kind engagement from policy and delivery agencies, making the overall leverage on central funding relatively high in practice.

Horizon Europe announces specific requirements on the maximum proportion of funds it can contribute to each funding call. These range between 70 and 100%, depending on the nature of the research. European Partnerships are also embedded in Horizon Europe. European Partnerships are strategic

[37] Australian Research Council. Linkage Projects. Accessed at: https://www.arc.gov.au/linkage-projects

collaborations between the EU Commission and public/private partners.[38] They pool resources, avoid duplication, and support EU priorities. Horizon Europe features 3 implementation modes for these partnerships:[39]

- Institutionalised Partnerships involve high-integration setups like joint undertakings with private/public partners.
- Co-funded Partnerships support joint research programmes, funding 30-50% of transnational calls and activities.
- Co-programmed Partnerships rely on Memoranda of Understanding and commitments from partners without specified funding details.

These variable funding rates and partnership models effectively lock in national and private co-funding, and, taken together, they deliver higher aggregate leverage than Endeavour typically achieves through Smart Ideas and Research Programmes.

While not a strict requirement, applicants to the National Challenge Fund are encouraged to work widely. Other programs administered by Research Ireland, such as the Strategic Partnership Programme, mandate that co-funding partners must commit to providing at least 50% of the direct project costs in cash.[40] This suggests that, within the same national funding system, challenge- and partnership-based schemes are using co-funding thresholds to push for stronger end-user ownership.

Overall, Endeavour's co-contribution settings sit within international norms for applied research, but are less demanding than the more leverage-oriented linkage and partnership schemes examined here, particularly in terms of minimum ratios and expectations about cash contributions.

5.3 Outcomes and impacts from funding

5.3.1 Nature and scale of outcomes and impacts

MBIE gathers annual updates and final reports from funding recipients, including the Endeavour Fund grant recipients, which capture information on project progress and research outputs. These include measures such as peer-reviewed publications, patents and new products, conference presentations, and the number of students supported to undertake doctoral and master's study (among other metrics).

International stakeholders did not present comprehensive assessments of the outcomes and impacts achieved through their respective organisations. They highlighted that these outcomes varied widely in scale, nature (economic, social, or environmental), and target beneficiaries. This variation is influenced by factors like the specific funding scheme, project scope, research field, partnerships, stage of development, and size of funding involved.

Australia's NCGP has a public-facing impact report, while Horizon Europe and the UK's SPF have undertaken interim evaluations of their respective funds' impacts. A direct comparison of the Endeavour Fund's whole-of-economy impact with that of the NCGP is outlined in the next section.

How these impacts are measured, monitored, and reported differs across the comparison countries, depending on the program's design and the level of maturity in how countries measure the impacts of research and innovation funding.

[38] European Commission. European Partnerships in Horizon Europe. Accessed at: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe/european-partnerships-horizon-europe_en

[39] Ibid.

[40] Research Ireland. Strategic Partnership Fund. Accessed at: https://www.researchireland.ie/funding/strategic-partnership/

The *ARC* has in place several systems for monitoring and measuring impact of NCGP-funded research:

— Grantees are required to submit final reports less than 12 months after finishing their project. There is currently minimal use of final report data analysis in external reporting. This reporting is collated by ARC and used for internal reporting and to inform evaluation.
— Evaluate individual schemes and supports, noting that these have been ad hoc and not heavily focused on research impact.

In 2023, the ARC commissioned ACIL Allen to evaluate the outcomes and impacts of NCGP-funded research over the past 2 decades and consider the potential future benefits delivered from the funding.

In assessing the outcomes and impact of NCGP-funded research, ACIL Allen drew on data provided by the ARC from 2002-2021. This includes funding data for 29,303 projects, 22,352 grant final reports, a survey of 3,361 researchers, and consultation with system leaders in Australia and international funding agencies. The evidence was analysed and synthesised using whole-of-economy modelling, impact case studies and qualitative and quantitative analysis.

The ARC uses media releases, government briefings, social media (LinkedIn, Twitter and YouTube), and publications (e.g. Making a Difference[41]) to communicate with stakeholders. Much of the ARC's communication on impact also occurs through in-person meetings.

UKRI uses both quantitative and qualitative indicators to capture research and innovation outcomes and impacts. Quantitative indicators include publications and citation metrics, patents and other intellectual property, spin-outs and start-ups, business growth, R&D investment, job creation and economic returns. For societal and policy impact, measures include health outcomes, environmental improvements and policy citations. Qualitative indicators are gathered through case studies, interviews, surveys and focus groups to understand drivers, barriers and enablers of impact.

UKRI tracks outcomes and impacts using grant monitoring systems, external data sources and mixed-method evaluations. Grant-holders are required to report outputs and outcomes at regular intervals, with wide-scale monitoring across the portfolio to capture a broad range of outputs and impacts. Data are collected annually through the standardised Researchfish system, which applicants must complete as a condition of funding. For innovation-focused projects, Innovate UK uses a tailored monitoring approach, collecting metrics aligned to business outcomes from funded businesses.

Many funds, including SPF, collect additional monitoring data that feed into independent evaluations commissioned by UKRI. These evaluations combine quantitative analysis with contribution analysis, case studies and, where possible, comparison groups. Depending on the evaluation, UKRI and external evaluators draw on publicly available data such as bibliometrics, patent databases and business data to examine collaboration, innovation activity and spin-outs.

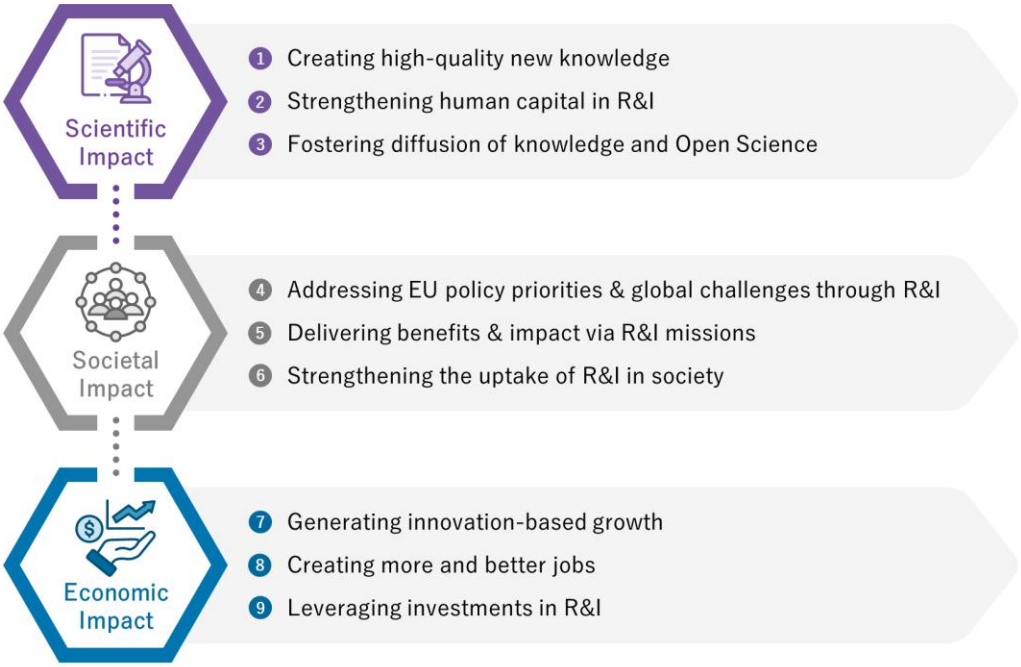
UKRI publishes case studies and articles on its website to showcase impact delivered.[42] These are deliberately published without cost benefit analyses to reinforce the message that research is valuable in many ways, many of which cannot be quantified. UKRI communicates the impacts of funded research through its website, social media, reporting to Government and ministerial briefings, reports to the research community and annual reports. Information is tailored to each organisation's areas of interest, needs and communication preferences.

Horizon Europe has a well-defined process for collecting evaluation data, guided by Key Impact Pathways, an indicator methodology and metadata handbook, IT systems, and a baseline and benchmark report. It aims to reduce researcher burden by linking researcher grant reporting and survey data with external databases, such as Scopus citation index to measure citations and Opus business database to identify start-up and spin-off companies. This also allows them to compare funded and non-funded businesses and thus

[41] Australian Research Council (2022). *Making a Difference*. Accessed at: https://www.arc.gov.au/news-and-publications/publications/making-difference
[42] UKRI. News. Accessed at: https://www.ukri.org/news/

understand the impact of the funding and the counterfactual scenario (i.e., what would have happened without the funding). Horizon Europe's evaluations focus on the program as a whole (not by stream or discipline).

Figure 5.4 Horizon Europe Key Impact Pathways



Source: Horizon Europe.

Horizon Europe employs quantitative and qualitative indicators via its Key Impact Pathways framework to measure research and innovation outcomes across scientific, societal, and economic dimensions. Quantitative metrics cover short-, medium-, and long-term progress, such as peer-reviewed publications, citation impacts, intellectual property rights like patents and trademarks, full-time equivalent jobs created or maintained, and leveraged public-private investments. These include targets like 35% of spending on climate goals and Sustainable Development Goals alignment; qualitative data emerge from surveys, interviews, case studies, and counterfactual analyses in evaluations.

Data collection is done through the electronic grant management system, which includes proposals, evaluations, periodic and final reports by grant recipients, and validation against external databases for publications, patents, and business records. Programme data is displayed publicly on the Horizon Dashboard.[43] Component-specific evaluations, like those for missions and partnerships, use mixed methods including economic modelling and biennial partnership reports.

An Interim evaluation of Horizon Europe (2021-2024) was completed in 2025. The evaluation relied on programme monitoring data from the Horizon Dashboard, administrative records, and external databases. Quantitative analysis used Key Impact Pathways indicators, and counterfactual methods (e.g., differences-in-differences, regression discontinuity where data allowed such analysis). Some whole-of-economy modelling was undertaken using the NEMSIS[44] and RHOMOL[45]O macroeconomic models. Qualitative inputs were drawn from external support studies analysing programme pillars and thematic areas, stakeholder

[43] European Commission. Horizon Dashboard. Accessed at: https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/horizon-dashboard

[44] European Commission (2025) New Econometric Model of Evaluation by Sectoral Interdependency and Supply. Accessed at: https://web.jrc.ec.europa.eu/policy-model-inventory/explore/models/model-nemesis/

[45] European Commission. Regional Holistic Model (RHOMOLO). Accessed at: https://joint-research-centre.ec.europa.eu/projects-and-activities/territorial-data-analysis-and-modelling-tedam/regional-holistic-model-rhomolo_en

surveys of beneficiaries and applicants, interviews of administrative stakeholders and a large number of case studies.

Impacts can be viewed via the Horizon Dashboard, which shows filterable data by programme pillar, country, or action type.

In its previous iteration as SFI, *Research Ireland* required its funding recipients to complete annual and final reporting. It accounts for the progress of individual awards against agreed milestones and the objectives of the funding call. Grants that were large, complex or awarded to first-time grantees are internationally peer-reviewed midway through the grant to identify whether the research is on track.

SFI did not rely on big data for collecting and analysing impacts, but given its position in the EU, it required interoperability with international standards and collection measures. This enabled SFI to track its performance longitudinally against its strategy, KPIs, and international benchmarks. SFI did not generally attempt to quantify economic impacts.

Research Ireland is now actively developing its impact monitoring for the National Challenge Fund, which represents a significant scale-up from earlier small-cohort programs where ongoing contact allowed close familiarity with progress.

Research Ireland conducts ongoing check-ins with National Challenge Fund teams and requires annual reports from them to track research outputs, publications, commercialisation activities, and additional funding from other sources. The program uses a theory of change framework with regular panels and international peer reviews during its lifetime. A large-scale evaluation is planned for next year.

5.3.2 Evidence of comparative economic impacts

Whole of economy impacts

Table 5.2 summarises the whole of economy impacts for the Endeavour Fund and ARC's NCGP program. Importantly, simple comparisons across impact studies can be misleading as many of them use different methodologies, assumptions and data. Table 5.2 indicates some of the key assumptions used for the assessments of both programs.

Table 5.2 Results of macro-economic modelling for Endeavour Fund and ARC NCGP

Metric	Endeavour Fund	ARC NCGP
CGE model used	Tasman Global	Tasman Global
Evaluation period	Grants awarded over 2016-2025 (10 years), with funds spent between 2017 to 2030	Grants awarded over 2002-2021(20 years), with funds spent between 2002 to 2026
Leveraged funds ($ in co-contributions for every $ invested by Government)	NZ$0.43	AUD$1.2
Ratio of increase in GDP to total funding (including co-contributions)	2.0 (at 7% discount rate) 2.8 (at 4% discount rate) [b]	1.6 (at 7% discount rate) [a]
Ratio of increase in GDP to government funding only (i.e. excluding co-contributions)	3.0 (at 7% discount rate) [c] 4.2 (at 4% discount rate) [b]	3.3 (at 7% discount rate) [d]
Comparison of key modelling assumptions		
Proportion of funds (including co-contributions) that get an economic return (based on researchers' surveys)	92%	72%
Time lags for accrual of benefits (based on researchers' surveys)	6 years for Smart Ideas projects and 4 years for Research Programmes projects	6 years for Discovery Projects and 4 years for Linkage Projects
Useful life of research	15 years	15 years
Industry sectors expected to receive the highest benefits from research modelled	– Agriculture, forestry and fisheries: 70% – Manufacturing: 20% – All other sectors: 10%	– Agriculture, forestry and fisheries: 23% – Manufacturing: 19% – Health care and social assistance: 16% – Information media and telecommunications: 9% – Mining: 8% – Electricity, Gas, Water and Waste Services: 6% – Construction: 4% – All other sectors: 15%
Discount rate (central)	4%	7%
Discount rate (sensitivity analysis)	2%, 8%	3%, 10%

[a] Estimated using data shown in Table 2.2 of ARC's Final report and Table 3.2 of ARC's Final technical supplement.

[b] As reported in Table 3.1.

[c] Endeavour's BCR, when calculated using only government funding, is lower than ARC's because government funding makes up a larger share of Endeavour's total funding (68%) compared to ARC (45%).

[d] As reported in Table 2.2 of ARC's Final report.

Source: ACIL Allen, ACIL Allen (2023). Impact Assessment of ARC-funded research. Accessed at: https://www.arc.gov.au/sites/default/files/2023-08/Impact%20assessment%20of%20ARC-funded%20research%20-%20Final%20report_0.pdf

In broad terms, macroeconomic outcomes for the Endeavour Fund are similar to those observed for the NCGP. When considering total funding, the estimated impact of the Endeavour Fund (measured as the ratio of GDP increase to funding) is slightly higher, but somewhat lower when co-contributions are excluded. These differences largely reflect the relatively higher share of co-contributions within NCGP funding.

The evaluation of Horizon Europe used macroeconomic modelling, which suggested that in the long-term, Horizon Europe is estimated to create a maximum of 63,000 jobs in 2033-2034 based on €22.8 billion in EU contribution to projects to June 2023. The table below summarises GDP gain based on macroeconomic modelling undertaken using 3 models.

Table 5.3 Results of macro-economic modelling for Horizon Europe Funding, by model (NEMESIS, RHOMOLO, FIDELIO)

Model	2021	2023	2025	2027	2030	2034	2040	2045
NEMESIS								
GDP gain (in bn €2020y w.r.t. reference scenario)	0.2	3.3	4.8	6.6	12.2	13.8	9.3	6.6
GDP gain (% w.r.t reference scenario)	0.00%	0.02%	0.03%	0.04%	0.08%	0.08%	0.05%	0.04%
RHOMOLO								
GDP gain (in bn €2020y w.r.t. baseline scenario)	0.3	11.1	13.3	11.6	9.9	8.1	6.1	4.8
GDP gain (% w.r.t. baseline scenario)	0.00%	0.08%	0.10%	0.09%	0.07%	0.06%	0.05%	0.04%
FIDELIO								
GDP gain (in bn €2020y w.r.t baseline scenario)	0.2	10.6	9.8	7	6.6	5.6	3.5	2.5
GDP gain (% w.r.t. baseline scenario)	0.00%	0.08%	0.07%	0.05%	0.04%	0.03%	0.02%	0.01%

Source: European Commission. Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024)

Indicators of other economic impacts

Horizon Europe commented on the international focus of its research, which is a direct result of the international-facing nature of the agency. All research is structured around the intended impacts and is required to contribute to 3 main domains of impact (science, society and economy).

According to the Interim Report, Horizon Europe has created or maintained 39,543 FTE jobs by organisations participating in the programme, based on data declared by 21% of funded projects before 6 January 2025.[46].

An interim evaluation of the emerging impacts of the SPF found that 6 spinout companies had been founded by funded program, equating to approximately 0.01 spinouts per £1 million (0.01 per NZ$2.26 million).[47] Given limitations in data platforms, it was not possible to make a direct comparison with the total number of spinouts from Endeavour-funded research.

Publications and IP

Comparing metrics across funds proves challenging due to inconsistent data availability, differing timeframes, and varying programme scales.

Despite these data inconsistencies across timeframes and scales, Endeavour Fund demonstrates competitive publication performance, averaging 19.7 papers per Research Programme, on par with Australia's NCGP Discovery (18.89). IP tracking gaps hinder a complete assessment, but the comparator

[46] European Commission (2025). *Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 - 2024)* p 53

[47] UKRI (2023). *SPF Interim Impact Evaluation – Main Report.* Accessed at: https://www.ukri.org/wp-content/uploads/2023/08/UKRI-04082023-Strategic-Priorities-Fund-interim-impact-evaluation-main-findings-report.pdf

funds' low outputs (Horizon's 124, SPF's 7) relative to their size suggest Endeavour's underlying innovation potential remains comparable.

Table 5.4 Publications and IP comparison

Fund/Funding mechanism	Time Period	Peer-Reviewed Publications (Total; Avg per project where available)	Total IP Outputs (e.g., patents)
Endeavour Fund (Research Programmes)	2017-2024	3,506 total; 17.2 avg	Data unavailable
Endeavour Fund (Smart Ideas)	2017-2024	3,506 total; 2.0 avg	Data unavailable
NCGP Discovery	2002-2021	283,181; 18.89 avg	Not reported
NCGP Linkage	2002-2021	115,485; 15.69 avg	Not reported
Horizon Europe	2021-2025	6,922, average not available	124
UKRI SPF	2018-Jun 2022	1,956, average not available	7

Source: ACIL Allen, Horizon Europe, UKRI

5.4 Lessons for Endeavour

Across the areas examined, the Endeavour Fund performs broadly in line with international comparators. Success rates are consistent with global benchmarks and reflect a similarly competitive funding environment, where increasing application pressure is a key driver of outcomes. The Fund's design also aligns with international practice, combining targeted basic and mission-based research, although many comparator systems separate these functions across distinct programmes. Co-contribution settings sit within international norms, albeit with less emphasis on leverage than some partnership-focused schemes.

In terms of outcomes, modelling suggests that Endeavour's macroeconomic and research performance is broadly in line with peer programmes. While assessing macroeconomic impacts across funds is challenging due to differences in modelling approaches and assumptions, the available evidence indicates similar levels of impact, with observed variation largely reflecting differences in co-contribution structures rather than underlying performance.

That said, our Evaluation comes at a time when significant structural changes are planned for New Zealand's research and innovation funding mechanisms, and it is a good time to reflect on how funds, like Endeavour should, be monitored, evaluated and reported in the future.

Based on what we have heard and observed from other funds with similar purposes, it will be important to:

— Capture the outputs of research grants in a way that they can be analysed using automated and machine learning techniques. These include the capture of publications, patients, and licences.

— Consider regular national surveys of research leaders who receive funding. These surveys should enable MBIE to monitor realised and expected impacts from the perspective of research leaders.

— Undertake impact tracing activities of exceptional research that support cultural impacts or policy outcomes, so strong and robust narratives of impact can be reported to decision makers and the broader community.

6 Concluding remarks

This section provides our final thoughts on the impact assessment.

6.1 The Fund's focus

While the impact assessment has naturally focused on the impact delivered by the Fund over its life, the quantum, nature and distribution of delivered impacts have been shaped by the Fund's guiding principles. These principles will be a key consideration as New Zealand redesigns its research funding landscape.

While ACIL Allen has not analysed the Fund's design and intent in detail, nor was it a core element of our scope, we observe Endeavour's design to be broadly appropriate. Through stakeholder consultation, survey feedback, and ACIL Allen's experience assessing other research funds and organisations, we believe that the Fund strikes a good balance between providing strategic direction by identifying Investment Signals and priority areas where research can create significant impact, and preserving the independence of researchers to determine their own pathways to achieving this impact. This balance establishes the right incentives at a system level as it guides the research community toward addressing national challenges while maintaining the diversity and originality needed for long-term innovation. In this manner, the Fund's model is comparable with leading international funds.

Requiring applicants to articulate their pathways to impact at the proposal stage is a strength. It encourages forward thinking, helps teams plan for translation and uptake, and embeds a culture of impact-oriented research without constraining academic curiosity. Other international funders, such as those in the United Kingdom, the EU, and Ireland, use similar mechanisms to bridge the gap between research excellence and practical application.

There is scope to refine how the Fund leverages partnerships with industry and international collaborators. Co-investment at the project level and strategic connection with international funds at the portfolio level would multiply the reach and sustainability of funded research, and align with comparable international funds that require such arrangements. Any future research funding would benefit from a similar approach to amplifying research impact, particularly for research that is more commercially-focused (above TRL 3).

As with any large system, the operationalisation of this intent is not perfect, and implementation processes can sometimes limit the intended impact. This is particularly apparent in the gap between excellent research and commercialisation, where very good projects often struggle to find appropriate end-users and markets. However, this is an issue that effects **all** public research funds, and is not particular to the Endeavour Fund. Overall, Endeavour's underlying investment logic appears sound and has a place in New Zealand's future research funding system.

6.2 Evidence of tangible impact

The Fund is delivering measurable impact across New Zealand's economy, science system, knowledge base, society, culture, and environment. Our analysis finds that these contributions occur both through the direct outcomes of funded research that were explicitly intended within project design, and through broader spillover benefits that extend across the innovation system and wider community. These represent the wider, often indirect, contribution of research investment to national prosperity.

The Fund is delivering strong, quantifiable economic returns. Our impact analysis shows that funded research is projected to increase New Zealand's GDP by a cumulative total of $29 billion over 2017-2048 and generate $6.30 for every $1 of government investment (which includes partner co-contributions to the

research). As a result, an additional 1,057 people will be employed in New Zealand every year. Funded research has delivered impacts associated with IP and patents, the commercialisation and licensing of technology, and the launch of start-up and spin-off companies.

The Fund is also deepening New Zealand's research capability and institutional strength. It supports projects that expand the national stock of knowledge and create new partnerships within the research system. Funded research has provided a pipeline for developing New Zealand's research skills and capacity, identifying new research directions that have informed or may inform further research.

Many of the projects examined in this report are producing important social, cultural, and environmental benefits that are not always captured by economic measures. Research supported by the Fund has improved community resilience and safety, enhanced health, wellbeing and quality of life, reduced hardship, and supported more effective risk mitigation in areas such as natural hazards, housing, and health. Similarly, the Fund has strengthened New Zealand's environmental and sustainability outcomes by developing evidence and tools that inform better environmental planning and decision-making, reduce ecological pressures, protect biodiversity, and restore natural habitats. Endeavour-funded projects affirm and apply Māori knowledge systems and enable Māori-led research and governance. By integrating tikanga and mātauranga Māori, these contributions promote cultural renewal, self-determination, and stewardship of heritage and environment. They also expand the inclusiveness and relevance of New Zealand's science system.

These outcomes highlight the scale and significance of the Fund's contribution to measurable economic and scientific value, while also generating wider benefits for New Zealand communities and industries. Many of these impacts would not have occurred without the Fund's scale, ambition, and approach to research investment.

6.3 Endeavour's full impact is not yet visible

The Fund is achieving measurable impact, but the full breadth of its contribution is not yet visible. There is an opportunity to strengthen how data and evidence are captured and communicated to reflect the Fund's total value to New Zealand. Many of the most important outcomes, such as knowledge creation, capability development, policy influence, and social or cultural change, require different forms of evidence and more systematic approaches to measurement.

Future grant reporting should place greater emphasis on collecting consistent data across the life of projects and beyond. This includes improving data collation on contributions to the national stock of knowledge, tracking collaborations and training outcomes, and following up with researchers after funding concludes. New Zealand should draw on good practice from comparable international research systems that capture and communicate impact more effectively. Many use structured data platforms, shared indicators, and qualitative synthesis to show how research connects to broader outcomes. Investing in similar infrastructure would strengthen how New Zealand's research impact is measured and communicated.

A specific opportunity lies in tracing policy and societal influence more systematically. Horizon Europe has recently adopted a framework to measure these longer-term societal impacts (which include policy impact). The framework is based on a set of indicators, structured around story lines that will use a combination of quantitative and qualitative data/evaluation techniques, to measure impacts that align with the specific and general objectives of the Horizon Programme.[48] Elements of this framework are aligned with good practice and could potentially be adopted by New Zealand in the future.

[48] See the 2023, Staff Working Document on the Horizon Europe monitoring and evaluation framework: https://research-and-innovation.ec.europa.eu/strategy/support-policy-making/shaping-eu-research-and-innovation-policy/monitoring-evaluation-and-impact-assessment-horizon-europe_en#impact-assessment-of-horizon-europe

Our observation is that the Endeavour Funded research has already informed public policy and decision-making, but these links are often under-reported and undervalued. Future mission-led funding should consider embedding an impact tracing methodology from the outset to map how ideas, evidence, and networks from research shape outcomes over time. This allows an understanding of how investment contributes to change, not just what that change looks like at a single point in time.

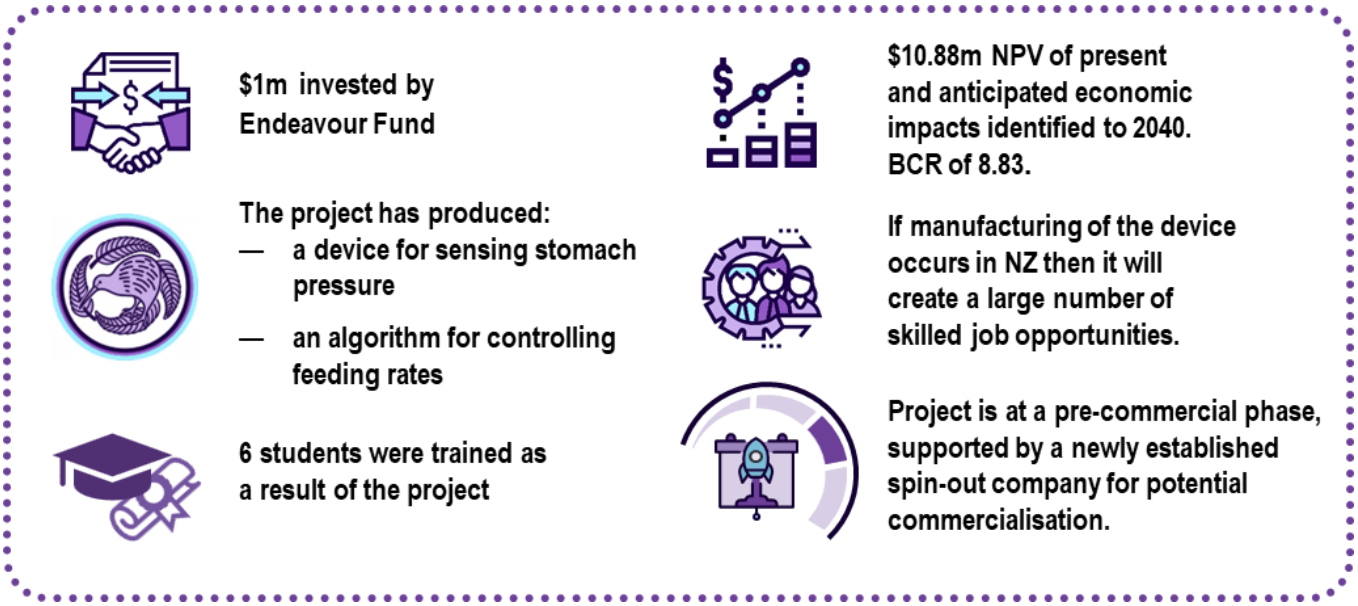
By improving how impacts are documented and communicated, future research funding can more effectively demonstrate its value to the public and inform better investment decisions.

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Part 2: Case Studies

7 Case Study 1: Augmented Nutrition

Augmented Nutrition used Smart Ideas Endeavour funding to develop a new hospital enteral feeding system that automatically adjusts feeding rates based on patient signals. Working closely with clinicians and industry, the team created a bench-top "phantom stomach", validated a way to measure relevant pressures outside the body using standard tubes, and built bedside prototypes and algorithms that are now being clinically evaluated and prepared for commercialisation through a New Zealand-based company.

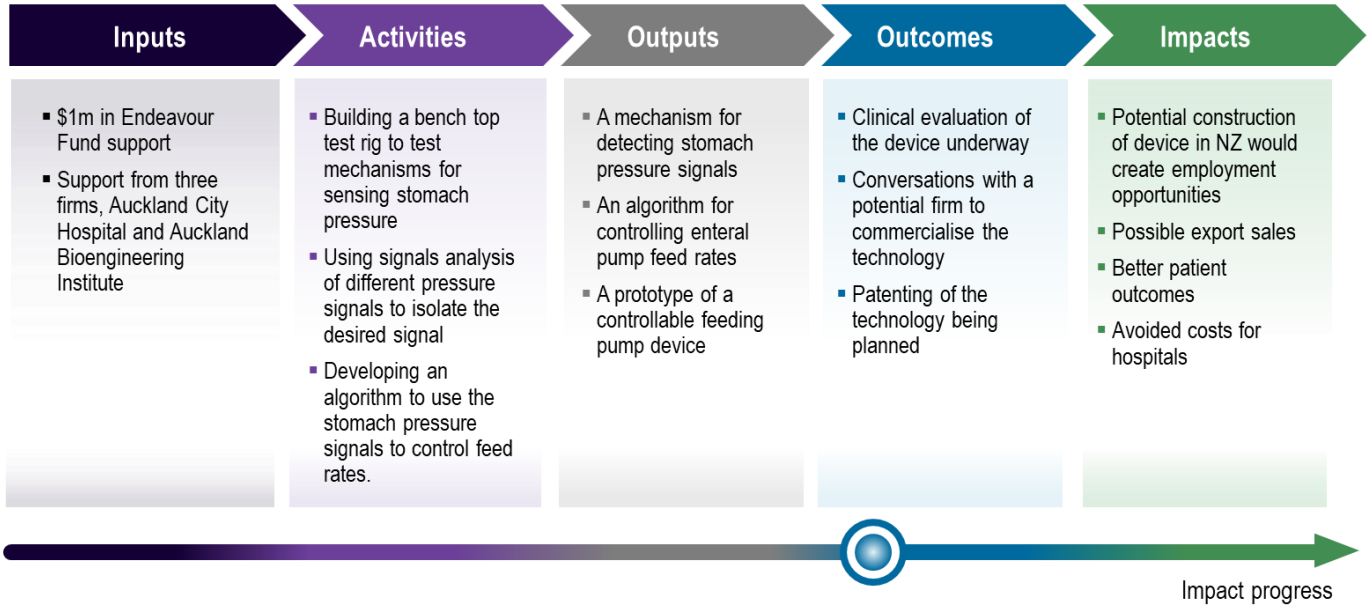


7.1 Case study framework

The framework used to evaluate and demonstrate the impact and value of the Endeavour-funded research into Augmented Nutrition is provided in Figure 7.1. The framework is based on best practice evaluation models and has been used by ACIL Allen to assess a large number of research organisations and funding mechanisms in Australasia.[49]

[49] The approach is based on that outlined in the CSIRO Impact Evaluation Guide. See https://www.csiro.au/~/media/About/Files/Our-impact-framework/CSIROImpactEvaluationGuide_Nov2015_WEB.pdf?la=en&hash=B351D24FB3CE02CB34FB859F2C34AA3940EE6D1F .

Figure 7.1 Augmented Nutrition – Impact Framework Diagram



Source: ACIL Allen

7.2 Background

Access to adequate nutrition is key to a person's health. When a person is unable to obtain sufficient nutrition (for example, if they are in intensive care or unable to eat for some other reason), they may need to be fed directly through tubes that deliver liquid food into their stomach or intestine. The current methods of delivering this extra nutrition include gravity feed or a simple pump. However, these one-size-fits-all approaches are not very efficient and can deliver suboptimal patient outcomes due to over or underfeeding.

This Smart Idea project sought to develop an alternative product that would provide a better way to ensure that the sick and infirm receive optimal nutrition. The aim was to develop a novel biofeedback-regulating system that uses information collected from the patient via sensors (such as pressure changes from intestinal contractions and heart rate) to directly control enteral feed tube pump flow rates in real time. This research offers an opportunity to develop a system for nutrition delivery optimised for each individual's ability to receive it.

7.3 Inputs

The Endeavour Fund provided $1 million (ex. GST) in cash for this project. The project commenced in late 2019 and concluded in early 2023 (see Table 7.1)and led by a team of researchers from Auckland City Hospital. The Smart Ideas project's longer-than-usual duration was due to delays caused by the COVID-19 pandemic. The project required establishing new collaborations among the research team, Auckland City Hospital clinicians, a signal processing expert, engineers, and private firms.

The research team worked closely with the Intensive Care Team at Auckland City Hospital, which included the Nutrition Support Team and the head ICU Dietitian. This enabled the researchers to obtain hospital access, submit and obtain ethical approval for the research, and obtain subject-matter expert feedback on the device and process. They collaborated with the General Surgery Department and the Intensive Care Unit (ICU), which gave the team access to the surgical wards and to post-operative surgical patients, as well as future end users of the technology.

The team also worked closely with the Auckland Bioengineering Institute., The Institute aided in the development of the device's prototypes and provided the resources needed to conduct lab testing. The research team also collaborated with a signal analysis engineer to help separate the desired pressure signal from the 'noise' being detected by their sensor.

While there is often a lag to most of the economic returns of research, the immediate economic impact is evident not only in salaries and project-related expenditure, but also in the way it stimulates demand for New Zealand-based technology services. The research team worked with 3 firms:

— Alimetry Ltd: This collaboration was to use Alimetry's gastric body surface mapping technology to assist with diagnosis and evaluation of enteral tube feeding (ETF) intolerance. It was intended that their signal would help to separate the desired pressure signal from the 'noise' caused by other factors (such as movement, coughing, breathing, etc).

— Medlink Innovation Ltd: This firm was subcontracted to assist with the critical project design and engineering work for the project. Medlink also provided technical support when the devices were deployed.

— Telemetry Research/Millar (NZ) Ltd: This firm designs and manufactures miniature pressure sensors. The research team procured some sensors from this company and obtained technical advice from them.

Support for the project was entirely sourced from the Endeavour Fund (see Table 7.1).

Table 7.1 Augmented Nutrition: Support for the project (ex. GST)

Contributor / type of support	2020-21	2021-22	2022-23	Total
Cash				
Endeavour Fund	$333,000	$333,000	$333,000	$1,000,000

Source: MBIE

7.4 Activities

The research team investigated various methods to measure pressure in a patient's intestine. A key challenge was that the patient's feeding tube is very thin, and it needs to be comfortable when inserted into the patient. The team initially looked to develop their own proprietary catheter. However, this path would have cost more than the available funding, so they sought off-the-shelf solutions. This approach was also preferable given the team's plans to commercialise the technology, as it was important to keep the product's price point in mind. The researchers ultimately came up with the idea of measuring the pressure in the column of feed fluid immediately after the feeding tube exited the nose as a proxy for the pressure in the intestine. The evidence showed that the pressure profile at the catheter tip is transmitted up the fluid column (liquid feed) and can be measured by a pressure sensor near the pump. This has the important advantage of moving all the sensing and controlling hardware outside of the patient. It also makes the technology compatible with most nasogastric tubes.

The researchers then built a sophisticated bench top test rig to evaluate all aspects of the technology as it was developed. The bench top testing apparatus consists of a wide sealed tube to mimic a 'phantom' stomach, a linear motor driving a piston to alter the phantom stomach pressure, and sensors to control the motor and measure the pressure. The phantom stomach could be programmed to reproduce the complex real pressure data captured from a clinical study participant's Enteral Feeding Tube (EFT) system.

There are many factors that can affect pressure in the feeding tube (such as coughing, patient movement, breathing, and heartbeats), making it difficult to isolate the pressure changes in the nasal food transfer tube of interest from those caused by other extraneous factors. These factors represented a major challenge in

using the information collected from the patient as input to an algorithm controlling the feeding rate through the tube.

The pressure signals from the phantom stomach were analysed to confirm that the dominant intestinal contraction frequency could be detected. The research team used changes in this frequency over time to control the speed of the peristaltic feed pump, namely, increasing its speed when the frequency decreased and vice versa.

In another test, the direct clinical stomach/intestinal pressure measurements were filtered to determine pressure amplitude over a 10-minute period. A change in amplitude over the subsequent 10-minute period was then used to adjust the peristaltic pump speed. For example, an increased amplitude was assumed to indicate higher gastric activity and, therefore, to signal slowing of the peristaltic pump.

The bench top testing of the first prototype enabled the team to demonstrate the whole process, from sensing the pressure to using that measurement to change the speed of a feeding pump. The team has since developed a second prototype for the bedside, which was more advanced (it collected heart rate and respiratory rate simultaneously to help deconvolute the pressure signal). This is a much more complex device test bed that lets the researchers program in various clinical pressure measurements from patients and then use these real-world mimics to test various aspects of their technology.

The team used the funding from the Endeavour Fund to make a first prototype of the bedside device. As a device for measuring a patient's medical signs, it had to be approved by the local Institutional Regulatory Board (aka Human Ethics Committee). The ethical approval for a range of clinical studies collecting data for this device refinement was obtained. The research team also obtained Health Research Council (HRC) funding to continue the ongoing clinical evaluation of the device algorithm. The team is now using a mix of healthy volunteers and patients to examine the factors that influence the signals detected by the device. At the same time, they are investigating additional physiological collection variables to inform the deconvolution of intestinal pressures. This will enable the researchers to further improve the algorithm for isolating the key intestinal pressure signal that controls the pump. This will enable the researchers to further improve the algorithm for isolating the intestinal pressure signal.

7.5 Outputs

The research on the Augmented Nutrition project delivered the outputs listed below.

7.5.1 Patents

The algorithm is treated as a trade secret. No patents have yet been applied for, but the research results are being treated as trade secrets. However, the researchers ultimately plan to obtain additional IP review of the final algorithm and data collection methods to determine if it can be protected with a patent prior to the full public commercialisation of the technology. This is planned for during 2026.

7.5.2 Commercialisation

Once the ongoing clinical trials are completed and the algorithm is finalised, the team plans to start the public commercialisation of the technology through a holding company, Novasyntec, which they have already established for this purpose. The plan is to engage with a smaller enteral feeding supply player that does not currently have significant market share. The device would offer a way to gain a technological competitive advantage over larger players to help the smaller firm to grow its market share.

The team has had initial discussions with a German firm that fits these criteria. They have expressed a strong interest in taking this discussion forward once the team has the project parameters and the device is completed. This will be revisited once patent(s) have been filed and the IP is protected later in 2026.

7.5.3 Models or tools

Phantom test bed: The researchers developed a bench testing rig and catheter sensor prototypes for evaluation throughout the project. They also built a bench top test chamber and a pressure detection system. This equipment was used to test and optimise prototype pressure and peristalsis sensing catheters. This chamber could be programmed with real pressure profiles from patient data to test catheter performance.

Data analysis: They also developed and refined the data acquisition, signal processing (used to filter the biological signals detected to identify the information that was of interest) and infusion pump control systems. They then developed an algorithm that uses the filtered signal as an input to determine the correct feeding rate.

Prototype: Finally, they constructed a series of prototypes that explored methods for building a controllable feeding pump unit that enables the control software to control the rate of the infusion pump. The bedside data collection model and pressure sensor are now in their second iteration. The prototype will be suitable for commercial demonstration, evaluation, and investment in product development.

7.5.4 Publications

The researchers published 4 peer-reviewed journal articles and 6 keynote presentations on this topic area over the course of the project.

7.5.5 Education

There have been 3 Honours students, 2 Masters students, and one PhD student directly involved in the Augmented Nutrition project.

7.5.6 Start-ups

A start-up company, NOVASYNTEC Ltd., has been incorporated by the 2 senior Investigators on this Smart Ideas project (Professors Phillips and Windsor). It will be the formal vehicle for the future commercial development of the technology. This will be the structure for future external investment once all the current grant funding is exhausted (in 2026).

7.6 Outcomes

Researchers used the funding from Smart Ideas to make a first version of the device. They are now undertaking a clinical evaluation of the device's performance characteristics in different clinical settings. The clinical work is funded by an HRC grant. Once the clinical trials are completed and the device algorithm details are finalised, the team plans to commercialise the technology through a holding company they have already established. The team has had initial discussions with a German firm. They have reportedly expressed a strong interest in continuing the discussions once the technology has patent protection.

7.6.1 Alignment with government strategic priorities

The project aligns with the Government's objectives of creating and growing knowledge-intensive industries.

7.7 Impacts

7.7.1 Economic impacts

Adoption

The researchers have estimated that the commercial roll out of the device could occur within 24 months. The intention is that the device will be manufactured in New Zealand.

Estimates of the global market for enteral feeding devices vary considerably (from $3.1 billion to $6.4 billion in 2024). Feeding pumps make up around half of that market. According to Growth Market Reports, the global Enteral Feeding Pump market size reached US$1.38 billion in 2024.[50] The market for pumps is projected to expand at a compound annual growth rate (CAGR) of 6.2% between 2025 and 2033, reaching an estimated US$2.37 billion by 2033.[51]

The research team sees the initial market for the device as ICUs, which have the most vulnerable patient group and the most expensive day-stay impact in the event of hospital-acquired pneumonia.

According to the Australia New Zealand Intensive Care Foundation, there were 283 Intensive Care Unit (ICU) beds in New Zealand and 2,372 ICU beds in Australia in 2024.[52] In 2024, 19,000 adult patients were admitted to the ICU in New Zealand, with a median length of stay of 1.8 days.[53] This implies that, on average, each ICU bed has 67 patients a year.

ACIL Allen has assumed that half the ICU patients will require enteral feeding. A 2023 journal article in Nutrition in Clinical Practice found that in enteral fed patients, aspiration pneumonia has a prevalence ranging from 4% to 95%.[54] For the purposes of our analysis, we have assumed that 5% of enteral fed patients will develop pneumonia because of complications associated with enteral feeding. The researchers have estimated that treating an ICU patient with pneumonia costs approximately $57,000 (USD$27,422 in 2016).[55]

The researchers have estimated that the impacts of using the feeding rate controller device will include:

- a reduction in time that the patient is in the ICU of 0.3 days. A 2019 report by the Medical Journal of Australia estimated the cost of operating an ICU bed at around A$4,400 per patient day (approximately NZ$6,500 in 2025 dollars)[56]
- a 15% reduction in the number of patients that develop aspiration pneumonia
- export revenue from the sales of the device in Australia. We have assumed that the device will sell for a one-off cost of US$1,000 per unit (NZ$1,673). In addition, there is a consumable component, namely

[50] https://growthmarketreports.com/report/enteral-feeding-pump-market accessed 2 February 2026

[51] The growth of pumps is a good surrogate for the growth potential of the device as it couples to a pump.

[52] https://intensivecarefoundation.org.au/about-intensive-care-units/icu-statistics/current-data-stats accessed 2 February 2026.

[53] Ibid.

[54] https://pubmed.ncbi.nlm.nih.gov/37227191/ accessed 3 February 2026.

[55] *Economic Burden of Ventilator-Associated, Hospital-Acquired, Healthcare-Associated and Community-Acquired Pneumonia in the Hospital Setting Open Access*, Diana Sun, PhD, MS , Open Forum Infectious Diseases, Volume 3, Issue suppl_1, December 2016, 1494, https://doi.org/10.1093/ofid/ofw172.1196

[56] https://www.mja.com.au/system/files/issues/211_07/mja250309.pdf accessed 3 February 2026.

the in-line pressure sensor and additional sensors (e.g. electrical/sound). These have been conservatively estimated to add a further US$100 (NZ$167) per patient.

To estimate the market share the enteral feeding pump control technology might capture, we have assumed it would be used to supply 10% of ICU beds in New Zealand by 2040, with uptake increasing following a Gompertz curve[57]. We also assume that the device would capture 2.5% of the Australian market by 2045, with uptake beginning 5 years after its launch in 2028. These are a set of conservative assumptions as we are including only these 2 countries in our analysis. Global sales and reduction in time spent in the ICU could be considerable.

Counterfactual

The researchers advised that they would not have developed the technology without funding from Endeavour. While they had access to a small amount of seed funding from the university, they faced multiple significant technical hurdles. The larger amount of funding provided under the Smart Ideas programme was critical to the project, as it supported engagement with the engineers and signal processing experts who were needed to build the initial prototype.

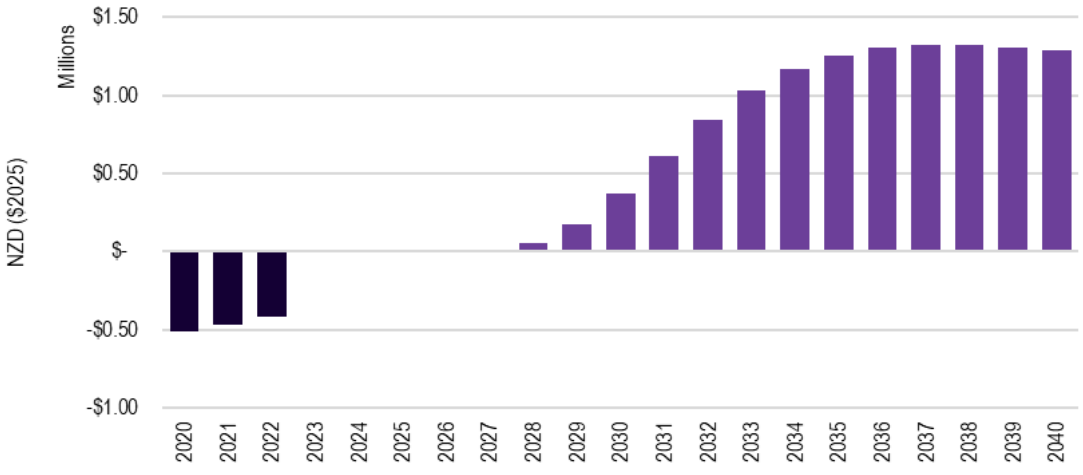
Attribution

This technology would not have been developed without the Endeavour Fund's support. However, we have assumed that 90% of any benefits that flow from this project can be attributed to the Fund to account for any unquantified in-kind support from the research team's host institution.

7.7.2 Calculation of NPV and CBR

The costs and benefits to New Zealand from the Augmented Nutrition Smart Ideas project are shown in the figure below.

Figure 7.2 Costs and benefits to New Zealand from the Augmented Nutrition project 2020-2040 (NZD $million, 2025 dollars)



Source: ACIL Allen

[57] A Gompertz curve is an S-shaped growth curve defined by an exponential decay in relative growth rate over time. It is commonly used to model processes where growth is rapid at first but slows as saturation is approached, such as market adoption.

It is estimated that, under the assumptions outlined above, the Augmented Nutrition project would generate: $12.3 million in additional value added.

In NPV terms, the overall benefit of the project using an 4% real discount rate could be **$10.9 million** (in 2025 dollars).

The BCR of the project, calculated as the present value of benefits divided by the present value of costs, is estimated to be 8.83. This means that, for every dollar in research grants invested in the Augmented Nutrition project, the Endeavour Fund enabled $8.83 in benefits to the New Zealand economy.

Sensitivity testing

Given the uncertainty associated with many of the assumptions used in the CBA, sensitivity analysis was conducted to assess the sensitivity of the results to substantial changes in the following assumptions:

— discount rate

— assumed percentage of ICU patients requiring enteral feeding

— uptake rate of product in New Zealand

— reductions in ICU stays as a result of using the new enteral feeding mechanism (i.e. changes in the expected efficacy of the product).

The results of the sensitivity analysis are presented in the table below. As shown in this table, the NPV remains positive (and the BCR remains above one) for all sensitivity testing, even with the most conservative assumptions.

Table 7.2 Sensitivity analysis – impact of sensitivity tests on the impacts

	NPV ($ million)	BCR
Central case	$10.88	8.83
Discount rate		
Decrease from 4% to 2%	$13.84	11.77
Increase from 4% to 8%	$6.63	5.09
Patients requiring enteral feeding		
Reduction from 50% to 30%	$6.05	5.36
Increase from 50% to 70%	$15.70	12.30
Uptake rate in New Zealand by 2040		
Reduction from 10% to 5%	$4.87	4.50
Increase from 10% to 15%	$16.89	13.15
Reduction in ICU stay in days as a result of using new feeding mechanism		
Change from 0.3 to 0.1 (not as effective as expected)	$4.29	4.08
Change from 0.3 to 0.5 (more effective than expected)	$17.47	13.57

Source: ACIL Allen

7.7.3 Social impacts

Educational impacts

Training and education were provided to 3 Honours students, 2 Masters students, and one PhD student over the course of the Augmented Nutrition project.

First Nations benefits

Māori are disproportionately impacted by acute and chronic diseases and are major users of enteral feeding services. There are persistent disparities in health outcomes between Māori and non-Māori populations. Between 2017 and 2019, Māori males and females had life expectancies of 73.4 and 77.1 years respectively, compared with 80.9 and 84.4 years for non-Māori. Recent Ministry of Health data indicate that Māori experience substantially higher rates of chronic disease, with cardiovascular mortality twice as high as for non-Māori, nearly double the prevalence of diabetes, and almost twice the hospitalisation rate for asthma among those aged 5–34.[58] They will therefore be direct beneficiaries of the improvements developed during this project.

Employment impacts

The researchers hope to manufacture the augmented nutrition solution they have developed in New Zealand. If this occurs, it is likely to generate numerous high-quality employment opportunities.

7.7.4 Other impacts

New collaborative partnerships

Over the course of this project, the research team developed collaborative relationships with Alimetry Ltd., Medlink Innovation Ltd., and the Auckland Bioengineering Institute.

The collaboration between the team and Alimetry Ltd is ongoing. Alimetry are developing surface electrical activity measurements of the stomach, and the research team are using that technology with their own to develop a hybrid device in the future.

7.8 Potential future impacts

The development of this device has spawned a range of follow-on activities and technical projects.

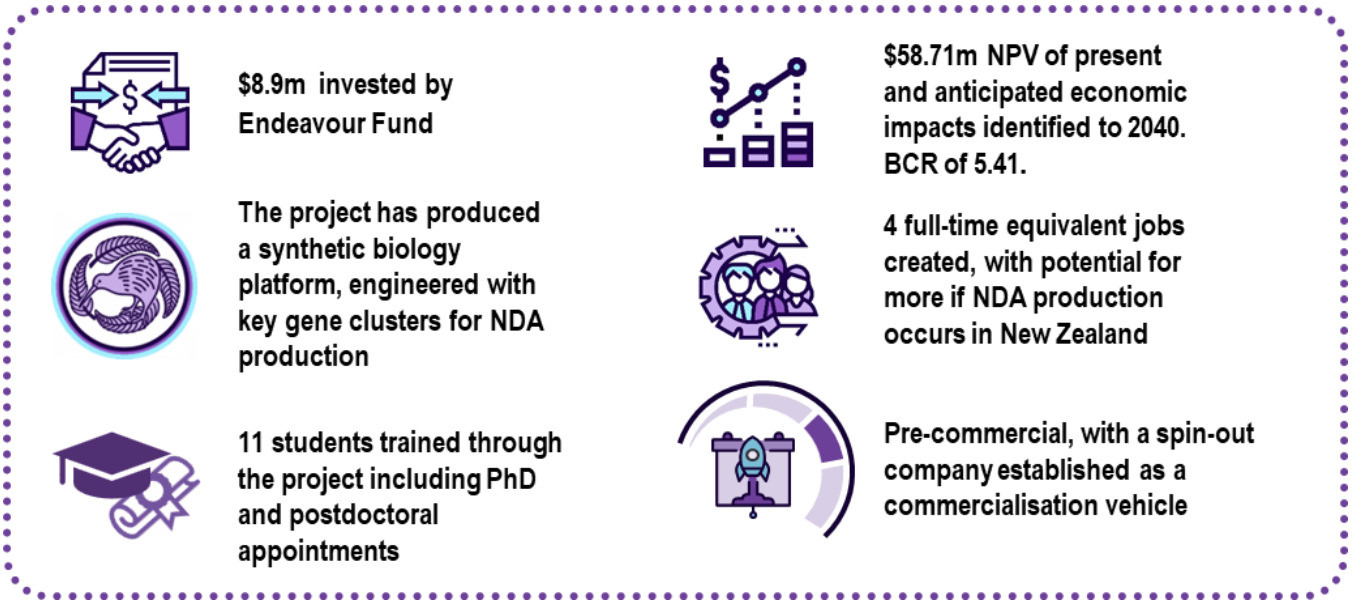
New Bowel Sounds Technology Project: The researchers have now developed a new concept idea related to passive and active measurements of bowel sounds from the body to determine feeding status and intestinal activity. The system will use a series of microphones and machine learning (AI) to detect sound patterns associated with abnormal bowel function that may relate to enteral feeding issues and to augment the sensitivity of the current device. It is anticipated that the information gained from monitoring bowel sounds can be integrated into a future commercial ETF device. A new grant has been obtained to explore, in part, this novel concept of assessing bowel sounds by AI that will have application back to this enteral project if successful (2025 HRC Explorer Grant).

[58] Sullivan T, McCarty G, Wyeth E, Turner RM, Derrett S. *Describing the health-related quality of life of Māori adults in Aotearoa me Te Waipounamu (New Zealand).* Qual Life Res. 2023 Jul;32(7):Accessed at: https://pmc.ncbi.nlm.nih.gov/articles/PMC10241673/pdf/11136_2023_Article_3399.pdf

New Abdominal Distention Technology Project: The research team are currently exploring a further technology direction on abdominal distention to see if this will also augment enteral feeding monitoring. This has come about from our understanding of enteral feeding issues. (Currently unfunded).

8 Case Study 2: Fungal Factories

Fungal Factories focused on using advanced fungal biotechnology to produce valuable natural compounds at scale, particularly safer insect control products for use in agriculture and animal health. The project delivered the upgraded Modular Idempotent DNA Assembly System (MIDAS 2.0), reconstituted the full DNA biosynthetic pathway in P. paxilli, optimised fermentation production, secured patents, and established the spin-out company Bontia Bio. The pathway to impact is through commercialisation of NDA for companion animals from 2028, expansion into production animal and crop protection markets, and generation of significant export revenue while strengthening New Zealand's bioeconomy.

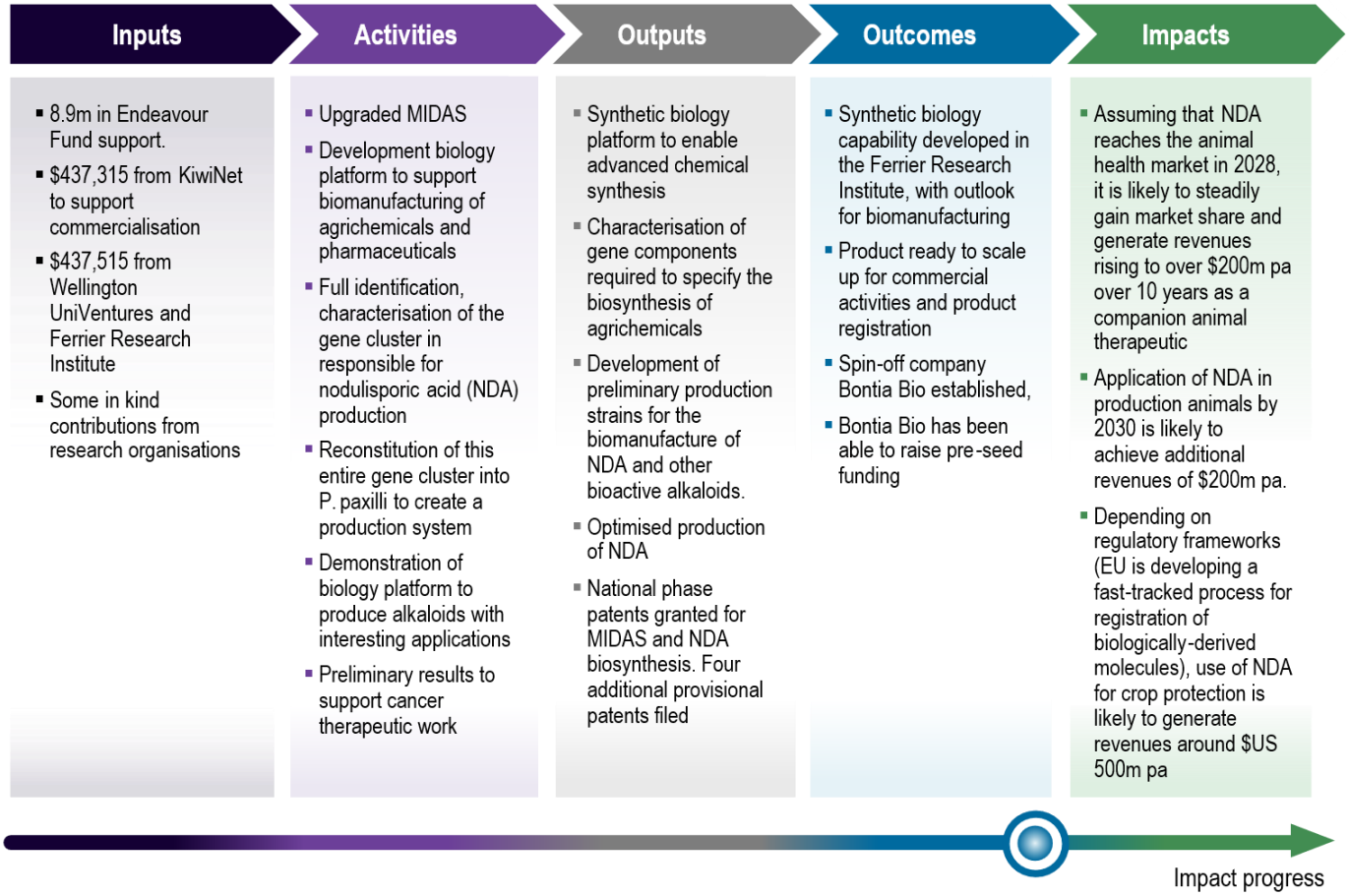


8.1 Case study framework

The framework used to evaluate and demonstrate the impact and value of Endeavour-funded research into Fungal Factories is provided in Figure 8.1. The framework is based on best practice evaluation models and has been used by ACIL Allen to assess a large number of research organisations and funding mechanisms in Australasia.[59]

[59] The approach is based on that outlined in the CSIRO Impact Evaluation Guide. See https://www.csiro.au/~/media/About/Files/Our-impact-framework/CSIROImpactEvaluationGuide_Nov2015_WEB.pdf?la=en&hash=B351D24FB3CE02CB34FB859F2C34AA3940EE6D1F.

Figure 8.1 Fungal factories – Impact Framework Diagram



Source: ACIL Allen

8.2 Background

For decades, many readily accessible bioactive products have been derived from plants and microorganisms; pyrethrins (used in insect control) are just one example. This research project has harnessed synthetic biology to scale the production of beneficial natural products that are normally produced in only minute quantities by their natural producers, but where chemical synthesis is prohibitively expensive due to their complexity. In a previous MBIE-funded Smart Ideas project, the researchers involved in the Fungal Factories project developed a unique synthetic biology platform that provides a quick and efficient way to combine genes to express entire metabolic pathways in compliant hosts. This approach has significant advantages over existing systems and provides New Zealand with a competitive edge in natural product biosynthesis and synthetic biology.

The research for this project was conducted by the Research Trust of Victoria University of Wellington with a team drawn from the University, Callaghan Innovation, Massey University, the University of Auckland, the University of Otago and AgResearch. The team, has focussed on a class of compounds called indole diterpenes and, one in particular, nodulisporic acid A (NDA), a complex potent bioinsecticide.

Synthetic biology has been used in this project to develop innovative, scalable systems for producing novel compounds, opening the door to new market opportunities. The project has developed an extensive fungal synthetic biology toolkit, designed to optimise the production of target natural products. This toolkit includes

the latest version of the custom-built Modular Idempotent DNA Assembly System (MIDAS 2.0), which enables rapid, efficient reconstitution of entire metabolic pathways in target hosts to maximise production.

Additionally, MIDAS combined with CRISPR-Cas9[60] genome editing techniques have enabled precise targeted integration and *in vivo* modifications, alongside the development of promoter screening assays, in order to optimise the genetic components. The project has used these tools to produce complex indole diterpenes via fungal biosynthesis.

Indole diterpenes are a diverse group of fungal-derived natural products, each exhibiting distinct potent bioactive properties (antimicrobial, anticancer and antiviral). This project focused on the production and biomanufacturing of indole diterpenes with beneficial attributes, offering significant commercial potential in animal health, crop protection, and human pharmaceutical markets.

The research team chose to first use the technology they developed to address the problem of flea and tick treatment for companion animals. Existing flea and tick products for companion animals have been dominated by products containing synthetic compounds. Resistance issues and regulatory changes are anticipated to create problems for existing solutions, making new compounds highly desirable. The use of bioinsecticide compounds, such as indole diterpenes, would provide a safer, more environmentally conscious alternative. The primary compound chosen is nodulisporic acid A (NDA). This compound was developed by Merck in the 1990s but never reached the market due to difficulties in chemical synthesis and the very low production levels of this compound from its natural source. The advantage of choosing this compound is that it has already been fully characterised[61] and in tests in several mammalian systems, there has never been any observable mammalian toxicity. This testing shortens the time and effort necessary to get the product to market.

The project team developed a process for making NDA by identifying and characterising all of the genetic components required for its production. NDA was first identified from a symbiotic fungus of the plant *Bontia daphnoides (*hence the name of the project's spin-off company, Bontia Bio). The genes required to make these compounds were engineered into laboratory strains of *P. paxilli (a filamentous mould)*, providing the basis for this novel process to manufacture the compound.

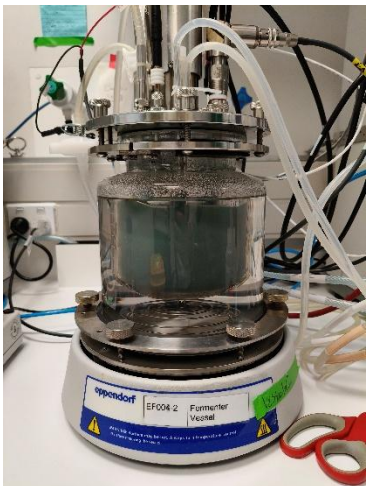
This project has developed a broader platform for the biomanufacture of complex, valuable compounds using sustainable fermentation methods, opening the door to a range of applications. Further compounds have also been successfully produced in this project and are being investigated for their insecticidal properties in a range of markets.

[60] CRISPR-Cas9 is a unique technology that enables researchers to edit parts of a genome by removing, adding or altering sections of the DNA sequence.

[61] Menke PT *et al,* 2009, Discovery of the development candidate N-tert-butyl nodulisporamide: a safe and efficacious once monthly oral agent for the control of fleas and ticks on companion animals, J Med Chem, 52(11):3505-15

[61] An assay is a laboratory test to find and measure the amount of a specific substance. A chromogenic reporter assay uses a colourless compound that an enzyme or microbe converts into a coloured product, allowing for easy visual detection

Figure 8.2 Fungal Factory



This project has used synthetic biology to scale the production of beneficial natural products that are normally produced in only minute quantities by their natural producers, but where chemical synthesis is prohibitively expensive due to their complexity.

This project has established a broader platform for the biomanufacturing of complex, valuable compounds through sustainable fermentation methods. This has created an opportunity for a range of different applications.

Image source: Professor Parker

8.3 Inputs

The Endeavour Fund provided $8,861,560 (ex GST) in support under the Research Programmes Funding stream. A cash contribution totalling $437,315 was provided by KiwiNet through the Pre-Seed Accelerator Funding (PSAF) to support the commercialisation of the research outcomes. The PSAF requires matched institutional funding. Co-investment equivalent to $437,315 was made by Wellington UniVentures and the Ferrier Research Institute. In-kind contributions were provided by the Ferrier Institute and several other research organisations. However, these contributions have not been quantified.

The research team members had expertise in molecular genetics, genome mining and annotation, chemical and synthetic biology, analytical chemistry, natural products synthesis and biosynthesis, microbial fermentation and process scale-up, bioactivity profiling and insect toxicity testing, neuro-oncology and manipulation of signalling pathways in stem and cancer cells. The team also had links and established partnerships with relevant commercial organisations with business management and market development skills.

Table 8.1 Support for the project

Contributor	2018-19	2019-20	2020-21	2021-22	2022-23	Total
Cash						
Endeavour Fund	$1,772,312,	$1,772,312	$1,772,312	$1,772,312	$1,772,312	$8,861,560
KiwiNet	$146,419	$159,176	$98,653	-	$33,067	$437,315
Wellington UniVentures and Ferrier Research Institute	$146,419	$159,176	$98,653	-	$33,067	$437,315
Grand Total	$1,1918,731	$1,931,488	$1,870,965	$1,772,312	$1,805,379	$9,298,875

Source: MBIE

8.4 Activities

As a first step, the project team upgraded the proprietary modular idempotent DNA assembly system (MIDAS) with new capabilities including the ability to combine modules for more effective gene mixing and matching, enabling rapid functional analysis.

The team also developed a novel genome editing method for *P. paxilli and a* chromogenic reporter assay for this organism.

The team then:

- identified the biosynthetic gene cluster responsible for NDA production
- characterised the function of each gene and inserted these genes in *P. paxilli* to reconstitute an entire functional biosynthetic gene cluster in this heterologous host
- developed fermentation processes for nodulisporic acids, in combination with the bioprocess development team at Callaghan Innovation, focusing on establishing yields under various conditions and the comparison of leading production strains
- optimised compound production using this system by reprogramming the genetic elements
- established spin-out company Bontia Bio to pursue biopesticide and animal health opportunities
- used the synthetic biology platform to produce a range of complex molecules that are insecticidal or potential anticancer therapeutics and undertook preliminary screening of these compounds. Positive results have been achieved for several compounds against a range of invertebrate pests. Separate assays for a subgroup of indole diterpene compounds demonstrated inhibitory effects against glioblastoma cell lines via modulation of a signalling pathway that becomes dysregulated in many types of cancer.

8.5 Outputs

8.5.1 Patents

Patent families for MIDAS and NDA biosynthesis are in various stages of national phase execution, with patents granted in some jurisdictions, including the USA. Since project completion, 3 provisional patent applications have been submitted (now filed as PCTs), relating to the biosynthesis of nodulisporic acids and other groups of bioactive indole diterpenes.

8.5.2 Innovation / commercialisation

The use of an advanced synthetic biology approach to produce NDA and related compounds is a significant innovation. Synthetic biology start-up company Bontia Bio has been spun out by Wellington UniVentures (the technology transfer office of Victoria University of Wellington) to commercialise nodulisporic acids in animal health and crop protection applications. UniVentures (and therefore Victoria University Wellington) is a key stakeholder in Bontia Bio and will benefit from the company's success.

8.5.3 Models or tools

Tools developed for this project have been described above.

- a new version of MIDAS (which enables the rapid and efficient reconstitution of entire metabolic pathways)

— a novel genome editing method for *P. paxilli*, eliminating the need for chemical selection, and allowing for precise genetic changes.

8.5.4 Publications

There have been 6 publications in peer-reviewed journals, most notably:

— Bundela R, Cameron RC, Singh AJ, McLellan RM, Richardson AT, Berry D, Nicholson MJ, Parker EJ, (2023) Generation of alternate indole diterpene architectures in two species of aspergilli. J. Am. Chem. Soc. 145, 2754–2758

— McLellan RM, Cameron RC, Nicholson MJ. and Parker EJ, (2022) Aminoacylation of indole diterpenes by cluster specific nonmodular NRPS-like enzymes. Org. Lett., 24, 2332-2337

— Richardson AT *et al*, (2022), Biosynthesis of nodulisporic acids: A multifunctional monooxygenase delivers a complex and highly branched array, Angew Chem. Int. Ed. **61,** e202213364

— Davidson EK, Freeman JL, Zhang W, Wuest WM, Furkert DP, Brimble MA, (2020) Asymmetric total synthesis of the naturally occurring antibiotic anthramycin.*Org. Lett.* 22, 5550-5554.

8.5.5 Awards

Professor Emily Parker received:

— 2023 NZIC Maurice Wilkins Prize for Excellence in Chemistry, for her role in spearheading New Zealand's participation in synthetic biology, leading a multi-institutional team to develop fungal biomanufacturing systems, including the MIDAS technology for assembling biosynthetic components

— 2025 Biotech NZ, Hall of Fame, for her significant contributions to New Zealand's biotech ecosystem, particularly her role in strengthening the connection between the industry and the government

— In 2019, she was elected as a Fellow of the Royal Society of New Zealand for her contributions to science.

8.6 Outcomes

An important outcome of this project was the creation of the spin-out company, Bontia Bio, which was selected to participate in the Sprout Agritech accelerator programme and has now received pre-seed-funding from New Zealand's Sprout Agritech and Booster Innovation Fund (combined initial investment of $375,000, with additional funds allocated for investment in the next round). Additional commercialisation and technical development plans are already underway for Bontia Bio as it plans to break into the animal health market in the USA. This is a key milestone towards the ultimate aim of building an internationally competitive synthetic biology platform that will establish microbial factories for the efficient and sustainable production of valuable compounds for both New Zealand and global markets. This initiative is expected to benefit the project's New Zealand commercial partners, generate significant export revenue, and create high-quality jobs.

8.6.1 Alignment with government strategic priorities

The New Zealand Government encourages the creation of commercial opportunities through transformational research. This work was ambitious but provided the opportunity to create commercial outcomes from science and to support the creation of new industry in the biomanufacturing space.

There has also been a clear intention of government to advance new technologies – synthetic biology firmly falls in this category and has been flagged for possible future investment alongside ambitions to enhance outputs from New Zealand's bioeconomy. Clearly, the integrated multidisciplinary programme of work required for this project supported that ambition and helped develop the workforce needed to meet this goal.

In addition, this work contributed to sustainability goals by using biological systems to do complex chemistry and deliver new biopesticide solutions. The outcomes of this project will support New Zealand's agricultural reputation and will also contribute to a more sustainable manufacturing base.

8.7 Impacts

8.7.1 Economic impacts

We have estimated the economic benefits of the Fungal Factories programme based on a conservative licensing-based framework. Under this approach, economic benefits to New Zealand arise from:

— upfront licensing payments (for animal health market only)

— ongoing royalty income (for both animal health and crop protection markets).

All projected revenues are expressed in real 2025 New Zealand dollars and discounted using a real discount rate of 4% to derive Net Present Values (NPV).

Companion animal flea and tick market

The world market for flea and tick treatments in 2025 was worth $US8.09 billion. It is expected to grow to $US12.63b by 2030.[62] The market for tick and flea treatments for cats and dogs is particularly strong and growing in the USA, Asia and Australia, with a compound annual growth rate (CAGR) of 9.32%.

The USA market for companion animal flea and tick products (more than $US 8b) is dominated by isoxazoline compounds including Boehringer Ingelheim's NexGard product line (approximately $US1b pa) Zoetis' Simparica, Merck's Bravecto, and Elanco's Credelio product lines, each generating hundreds of millions of US dollars per annum. Smaller non-isoxazoline product lines, such as Elanco's Seresto collar, with active ingredients neonicotinoid imidacloprid and pyrethroid flumethrin, generate approximately $US300m in revenue a year.

NDA has the potential to be launched as a premium product if taken to market by one of the leading animal health companies. The superior attributes from the consumer's perspective would be that NDA is derived from nature and offers a broader safety margin than competitor products. We note that the US FDA recently issued a safety alert to veterinarians and pet owners on the use of isoxazolines. From the perspective of an animal health company, NDA produced using this technology offers a larger profit margin due to the lower production cost of the product.

Assumed commercialisation structure

For the purposes of this analysis, it is assumed that New Zealand retains ownership of the intellectual property (IP) associated with NDA, while an established multinational partner supports regulatory approval and global commercialisation. That partner thus takes on operational responsibility and regulatory risk, and provides the capital requirements for (possibly large-scale) production.

[62] Mordor Intelligence, 2025, Flea and tick products market size & share analysis – growth trends & forecasts (2025-2030), accessed on 3 January 2026 at https://www.mordorintelligence.com/industry-reports/flea-and-tick-product-market-- ,

This reflects the prevailing structure of biopharmaceutical innovation, where firms operate within increasingly integrated and externally coordinated R&D networks, relying on specialist partners for capital-intensive manufacturing and complex regulatory execution. Industry literature shows that pharmaceutical development is commonly externalised at later stages due to high costs, specialist capability requirements, and regulatory complexity, with large firms and contract organisations undertaking scale-up and commercial delivery while smaller innovators retain upstream discovery and IP.[63]

Under this structure, 100% of the relevant IP value is treated as attributable to New Zealand entities with royalties and licensing proceeds. Actual realised benefits will ultimately depend on the negotiated terms of any licensing or exit agreement.

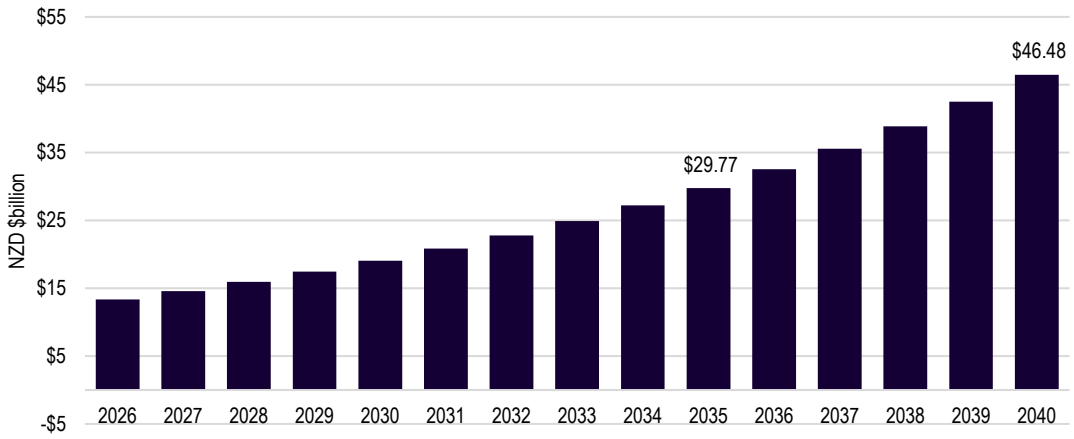
Sales projections

All royalty and upfront licensing calculations are based on projected NDA sales in the global companion animal flea and tick market.

Projected sales have been estimated using a structured market modelling approach:

— the global market for flea and tick market has been projected out to 2040 based on current market size and expected growth rates. This establishes the projected total addressable market over the evaluation period.

Figure 8.3 Forecast of the global flea and tick market out to 2040



Source: ACIL Allen

Other assumptions include:

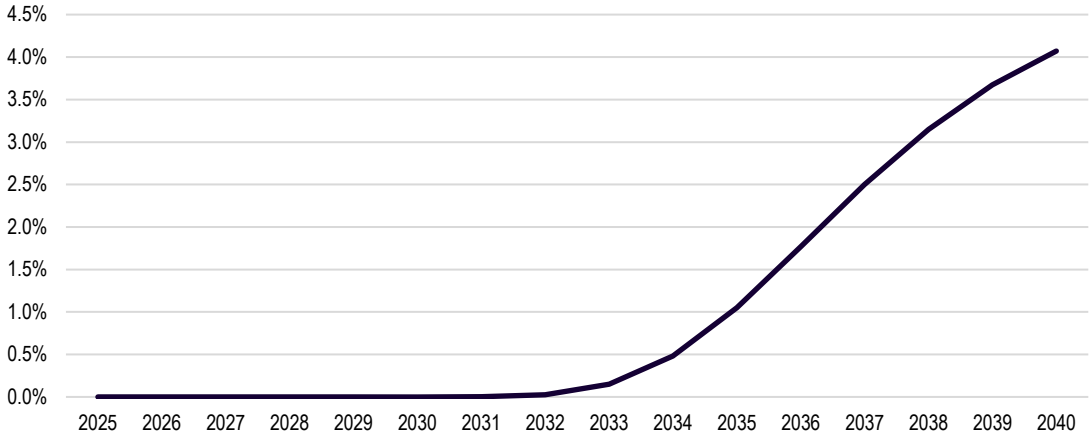
— a staged geographic rollout. Market entry is modelled to occur first in the United States, then in Europe, and subsequently in other major markets. This reflects typical commercial sequencing for novel animal health products and aligns with regulatory and partner capability considerations.

— market penetration has been estimated using a Gompertz curve[64] to simulate adoption over time. The Gompertz function is widely used in technology and pharmaceutical forecasting to represent initial gradual uptake, accelerated growth during the adoption phase, and eventual stabilisation of demand as the market matures.

[63] Steadman, V. 2018. *Drug Discovery: Collaborations between Contract Research Organizations and the Pharmaceutical Industry.* ACS Med. Chem. Lett. 2018, 9, 581−583; Yashiro, K et al. 2024. *The rise of spin-offs: Fueling pharmaceutical innovation through collaboration*. Journal of Open Innovation: Technology, Market, and Complexity. https://doi.org/10.1016/j.joitmc.2023.100200

[64] A Gompertz curve is an S-shaped growth curve defined by an exponential decay in relative growth rate over time. It is commonly used to model processes where growth is rapid at first but slows as saturation is approached, such as market adoption.

Figure 8.4 Estimated global market penetration of NDA



Source: ACIL Allen

Under this approach, NDA's annual revenue in each year is calculated as:

$$Projected\ global\ market\ size\ \times\ modelled\ NDA\ market\ share$$

This methodology ensures that projected sales reflect underlying market growth, staged expansion and realistic adoption dynamics rather than immediate full penetration. These projected annual sales form the basis for both the upfront licensing valuation and the ongoing royalty calculations.

Expected upfront payment

The expected upfront payment has been estimated using a revenue multiple approach consistent with industry practice for early-stage biotechnology assets without an established sales history.

Industry consultation indicates that comparable transactions for novel compounds at or near regulatory approval are typically valued at 2-3 times forecast peak annual sales. This analysis applies a conservative multiple of 2 times projected peak annual United States sales, with the peak defined as occurring 5 years post-launch to reflect early commercial maturity.

To capture regulatory and market risks in early-stage biotech valuation, we have adjusted for a 25% probability of technical and commercial success. A risk-adjusted net present value (rNPV) framework is applied, whereby expected future cash flows are weighted by the likelihood of successful commercialisation.[65] This approach explicitly incorporates regulatory, technical and market risk rather than embedding risk solely within the discount rate.

Royalty income

Annual royalties are calculated as:

$$Royalty\ =\ 3\%\ \times\ projected\ annual\ sales \times\ probability\ of\ technical\ and\ commercial\ success$$

As in the case of the upfront payment, a 25% probability of success is applied, consistent with the early-stage biotech development risk. The resulting expected royalty stream is discounted to present value in real 2025 New Zealand dollars.

[65] https://www.analysisgroup.com/globalassets/insights/publishing/2024-biotech-asset-valuation-methods.pdf

Crop protection market

In addition to the flea and tick market, NDA products also have an application in the crop protection market. Bontia Bio has already been in discussion with possible industry partners.

Advice from the project's international industry partner indicates that the first NDA crop protection application, targeting a specific plant pest in a single overseas jurisdiction, could generate approximately $100 million in steady-state annual sales once commercialised.

Economic benefits to New Zealand have been estimated on a royalty-only basis. No upfront licensing payment has been assumed, reflecting the current nature of commercial discussions and providing a conservative estimate of value.

Annual revenues modelled in constant (real) terms, with peak sales of $100 million informed by stakeholder consultations regarding commercial potential and market positioning. This peak is reached gradually following a Gompertz diffusion curve, which reflects realistic market adoption dynamics. Once the annual revenues are set along this ramp, each year's figure is escalated by a 14% CAGR to account for sector-wide growth, consistent with published projections in the biopesticide sector over 2025-2030.[66] Using this method, revenues reach $114 million by 2040, the final year of the evaluation period.

Annual royalties are calculated as:

$$Royalty = 3\% \times projected\ annual\ sales \times probability\ of\ technical\ and\ commercial\ success$$

A royalty rate of 3% is applied, with a 45% probability of technical and commercial success reflecting the relatively advanced stage of development. The resulting royalty stream is expressed in real 2025 New Zealand dollars terms and discounted to derive the Net Present Value of the benefits to New Zealand.

Unquantified opportunities

NDA also has potential applications in farm animal health, which could generate additional annual revenues of hundreds of millions of dollars. Due to the early stage of development and limited commercial data, no benefits from these applications have been included in this assessment.

Counterfactual

Without Endeavour Fund support, it is unlikely that the outcomes achieved by this project would have been achieved now or in the foreseeable future.

Attribution

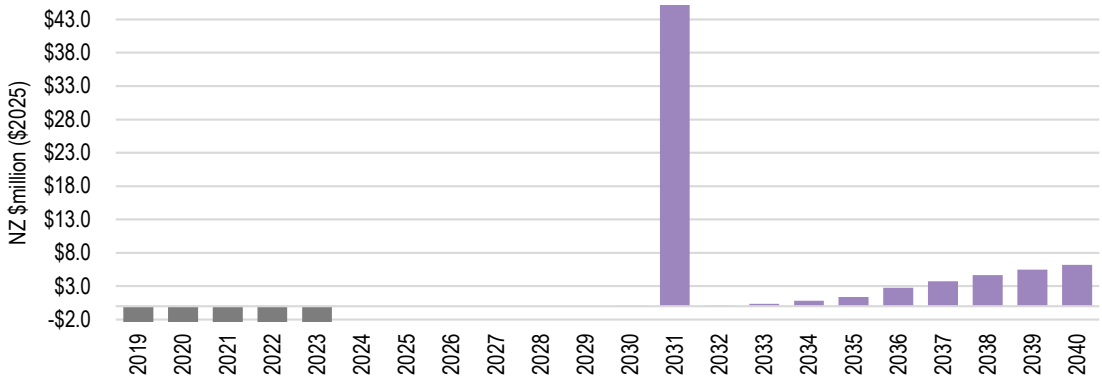
For the purpose of this analysis, 91% of both costs and benefits can be attributed to Endeavour Fund, consistent with its proportion of total New Zealand funding for the programme.

8.7.2 Calculation of NPV and CBR

The estimated costs and benefits to New Zealand from the Fungal Factories programme is shown in the figure below (Figure 8.5). It summarises the impacts over the period 2025-2040 in constant 2025 NZD.

[66] https://www.marketsandmarkets.com/Market-Reports/crop-protection-380.html

Figure 8.5 Costs and benefits to New Zealand from the Fungal Factories project 2025-2040



Source: ACIL Allen

Under the assumptions outlined above, it is estimated that the Fungal Factories project would generate $72.02 million (in 2025 dollars) in licensing fees and royalty payment from the sale of the NDA product as a premium product in overseas markets over the evaluation period from 2025-2040. The present value of project costs, comprising research funding (in 2025 dollars), is $13.32 million (in 2025 dollars).

In NPV terms, the overall benefit of the project in 2026 using an 4% real discount rate could be $58.71 million (in 2025 dollars).

The BCR of the project, calculated as the present value of benefits divided by the present value of costs, is estimated to be 5.41. This means that every dollar invested in the Fungal Factories project by the Endeavour Fund produced $5.41 in benefits.

Sensitivity testing

Given the uncertainty associated with many of the assumptions used in the CBA, sensitivity analysis was conducted to assess the sensitivity of the results to substantial changes in the following assumptions:

- the discount rate
- the licensing multiple applied to estimate the expected upfront payment
- the assumed probability of technical and commercial success across both animal health and crop protections markets.

The results of the sensitivity analysis are presented in Table 8.2. As shown in this table, the BCR:

- increases with:
  - a reduction in the discount rate
- decreases with:
  - an increase in the discount rate
  - a reduction in the licensing multiple from 2 times peaks sales to 1 times peak sales for the expected upfront payment in the animal health market
  - lower probability of technical and commercial success across both the animal health market (reduced to 10%) and the crop protection market (30%).

Table 8.2 Sensitivity analysis – impact of sensitivity tests on the economy wide impacts

	NPV ($million)	BCR
Central case	$58.71	5.41
Discount rate		
Decrease from 4% to 2%	$71.20	6.92
Increase from 4% to 8%	$38.82	3.39
Change in assumed licensing multiple for expected upfront payment in the animal health market		
Decrease from 2 times peak sales to 1 times peak sales	$34.77	3.61
Reduction of the probability of technical and commercial success		
– Decrease from 25% to 10% in the animal health market – Decrease from 45% to 30% in the crop protection market	$17.01	2.283

Source: ACIL Allen

8.7.3 Social impacts

Educational impacts

There were 4 PhD completions from this project. In addition, 7 post-doctoral researchers gained valuable experience.

Māori benefits

All New Zealanders are expected to benefit from the development of NDA.

Employment impacts

Bontia Bio currently has 4 employees, with the opportunity to expand. Production of NDA in New Zealand could support the creation of additional high-skilled jobs in synthetic biology, including roles in bioprocess development, fermentation scale-up, and advanced manufacturing, consistent with the programme's aim of building an internationally competitive microbial production platform.

8.7.4 Other impacts

The ready access to compounds that come from natural sources provides a rich choice of solutions for existing problems, particularly in agricultural settings where those solutions may be more environmentally benign. There are broader opportunities for these compounds in other industries and the future of synthetic biology and biomanufacturing for New Zealand. This work has put New Zealand research on the world stage, demonstrating New Zealand's ambition in synthetic biology and supporting a growing interest in commercial biomanufacturing.

8.8 Potential future impacts

These are other opportunities to develop products for agricultural animals. The bioinsecticide potential of this whole compound class is substantial. The synthetic biology approach developed by this project has made access to commercial applications of these compounds feasible. The possible application of NDA to address the increasing problem of ticks in New Zealand farm animals could have significant impact. For example, cattle ticks are causing significant, ongoing economic losses in the New Zealand dairy industry, primarily by

transmitting *Theileria orientalis* (a parasite that causes severe anaemia, milk production drops, reduced weight gain, and mortality, particularly in calves and around calving/weaning). The benefits to New Zealand from preventing the transmission of this parasite could be significant. In one season, a farm in New Zealand was reported to have incurred losses of $1 million.[67] In addition, there is significant potential for this technology to address fly strike which is an ongoing problem for New Zealand's sheep farmers with a significant animal welfare burden and associated economic losses.

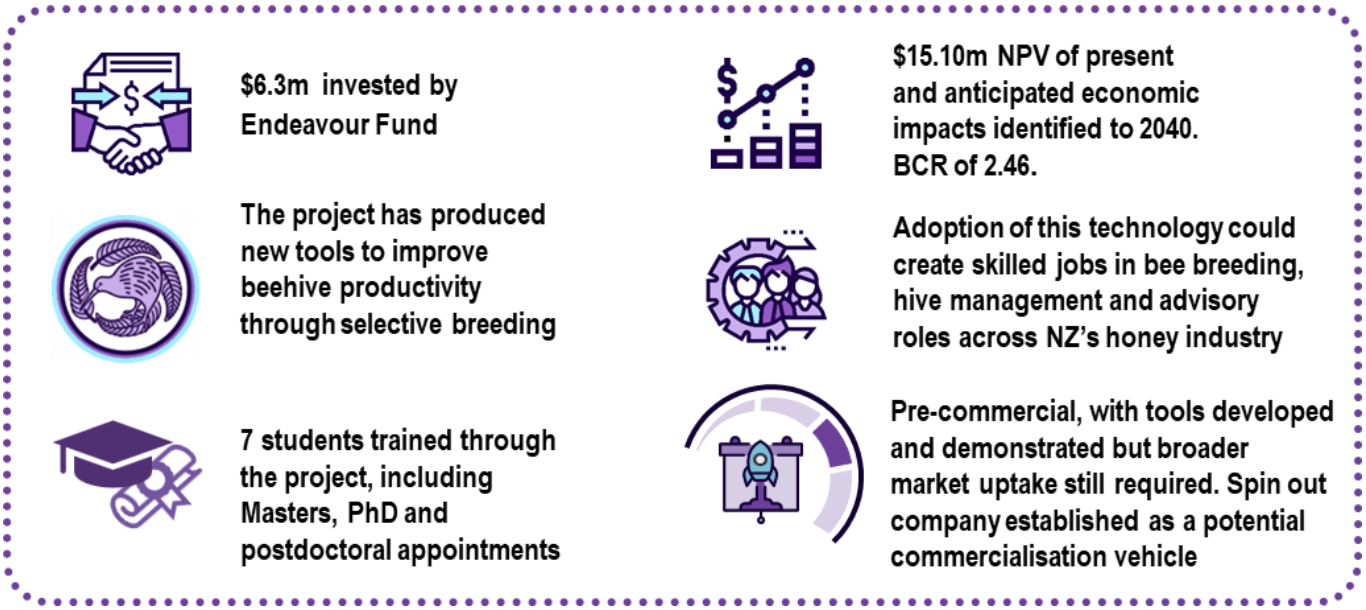
In addition, the bioinsecticide potential of this whole compound class is substantial. The synthetic biology approach developed by the researchers has made increased the prospects of developing commercial bioinsecticide applications.

There is also scope for this approach to be used to identify and produce other indole diterpene compounds with applications in human medicine. The early positive results of the preliminary screening already undertaken by the project team is an indicator of the technology's enormous potential.

[67] Theileria Working Group, 2015, Theileria Veterinary Handbook 2. Ministry for Primary Industries; Wellington, New Zealand, pp 1–32.

9 Case Study 3: Future Bees

Future Bees focused on developing modern bee-breeding methods and tools, and supporting commercial delivery of these, to produce healthier, more productive bee stocks that strengthened honey production and crop pollination. While the scientific toolbox and commercial pathway (via Future Bees NZ Ltd) are established, industry uptake has been constrained by weak market conditions and limited capacity to invest. The pathway to impact depends on renewed investment and coordinated industry action to drive adoption, expand managed pollination services, strengthen mānuka and other honey exports, and safeguard horticulture sectors worth over $8 billion annually that increasingly rely on resilient managed bee populations.

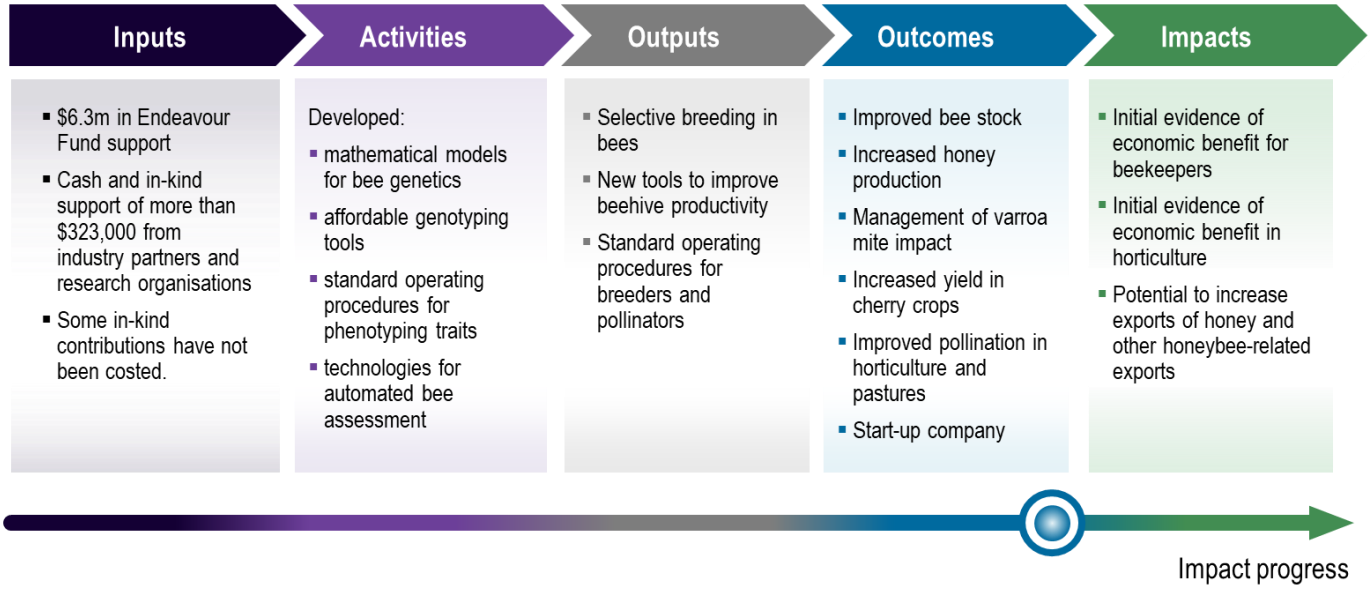


9.1 Case Study Framework

The framework used to evaluate and demonstrate the impact and value of Endeavour-funded research into Selecting Future Bees is provided in Figure 9.1. The framework is based on best practice evaluation models and has been used by ACIL Allen to assess a large number of research organisations and funding mechanisms in Australasia.[68]

[68] The approach is based on that outlined in the CSIRO Impact Evaluation Guide. See https://www.csiro.au/~/media/About/Files/Our-impact-framework/CSIROImpactEvaluationGuide_Nov2015_WEB.pdf?la=en&hash=B351D24FB3CE02CB34FB859F2C34AA3940EE6D1F.

Figure 9.1 Selecting future bees – Impact Framework Diagram



Source: ACIL Allen.

Note: Not all in-kind contributions could be costed because of data availability.

9.2 Background

Honeybees are an important component of food production in New Zealand, producing $504 million in hive product exports in 2020[69]. In addition, the New Zealand Beekeepers Association has reported that managed honeybee pollination in New Zealand contributes an estimated $5 billion annually[70] to the economy by supporting vital horticultural sectors such as kiwifruit, apples, and berries. Honeybee pollination is also crucial for clover, which supports pasture viability. The broader value derived from honey bee pollination services dwarfs the direct revenue and expert values from the honey bee sector itself.

[69] IBISWorld, 2025, Beekeeping in New Zealand (www IBISWorld.com)

[70] Apiculture New Zealand, 2023, Thriving together: New Zealand Honey Strategy 2024-2020, accessed on 2 January 2026 at NZ-Honey-Strategy-2024-2030-FINAL-version-for-web-20-Feb.pdf

Figure 9.2 Beekeeper examining a frame from a hive



Improving the robustness and quality of New Zealand's honeybee stocks is critical to improving and securing New Zealand's position as a supplier of premium honey to local and world markets.

The project has developed genetic tools and understanding to support modern selective breeding in bees. It has also developed and tested lines of bees with improved pollination activity, disease resistance, increased honey production and better temperament.

There is now a better understanding of how best to deploy improved genetic stocks in the New Zealand beekeeping industry. This project is revolutionising New Zealand's apiculture industry by enabling breeders to apply modern genetic tools to honeybees to precisely select key desirable traits.

Source: Richard Hall, NZ Ministry of Primary Industries

9.3 Inputs

The Endeavour Fund provided $6,344,620 (ex GST) in support under the Research Programmes funding stream. Cash contributions totalling $36,800 were received from Betta Bees Research Ltd and Taylor Pass Honey. Betta Bees Research also provided $287,500 as in-kind contributions for this project (see Table 9.1). Several other honey industry parties and research organisations also provided in-kind support that has not been quantified for this case study.

The research for this project was conducted by a team of researchers drawn from the University of Otago (leader), Cawthron Institute, AgResearch, Plant and Food Research, Betta Bees Research Ltd, Abacus Bio Ltd and Midland Seeds. Team members' expertise included honeybee research, agricultural genetics and genomics, breeding programmes, modelling and quantitative genetics, honeybee artificial insemination, Genotyping by Sequencing (GBS), pollination analysis, and cryopreservation of bee sperm. An industry advisory group met bi-annually and its chair attended research team and research leader meetings. The project drew on previous work by members of the research team.

Table 9.1 Support for the Selecting Future Bees project

Contributor/type of support	2017-18	2018-19	2019-20	2020-21	2021-22
Cash					
Endeavour Fund	$1,268,924	$1,268,924	$1,268,924	$1,268,924	$1,268,924
Betta Bees Research Ltd	$9,200	$9,200			
Taylor Pass Honey	$17,250	$17,250			
Total (cash)	$1,485,712	$1,485,712	$1,459,262	$1,459,262	$1,459,262
In-kind					
Betta Bees Research Ltd	$57,500	$57,500	$57,500	$57,500	$57,500
Total (in-kind)	$57,500	$57,500	$57,500	$57,500	$57,500
Grand Total	$1,543,212	$1,543,212	$1,516,762	$1,516,762	$1,516,762

Source: ACIL Allen from project final and annual reports.

9.4 Activities

The project has developed leading-edge bee breeding technology for the New Zealand beekeeping industry. To do this, it has developed:

- genetic, genomic and sound-based tests to monitor honeybee hive health
- the key science and technologies needed to deliver a bee breeding programme
- new genetic and genomic knowledge and technologies to support bee breeding
- new ways of monitoring and assessing beehives for breeding purposes
- a new understanding of bee biology of importance to bee breeding and bee health
- new information about what beekeepers wish to breed for and how to ensure implementation
- new technologies for assessing pollination success.

The project's industry partners included Apiculture NZ, the Foundation for Arable Research, Tai Tokerau Honey, and Ngati Potou Miere. International collaborators from the University of Dusseldorf (Germany), the University of British Columbia (Canada) and the Institut national de la recherche agronomique (France) also assisted.

A spin-out company, Future Bees New Zealand Ltd, has been established to deliver breeding advice and diversity information to New Zealand beekeepers.

9.5 Outputs

Outputs have included:

- standard operating procedures for breeders and pollinators
- genotyping systems enabling low-cost assessment
- breeding tools for selecting improved bee stock.

The outputs from the project will create industry-wide benefits flowing to multiple companies and the horticulture and honey sectors. There are export opportunities through the export of queen bees and the

sale or licensing of germplasm. In addition, there have been publications on bee reproduction, breeding and genetics.

9.5.1 Innovation/commercialisation

Modern genomic selection has increased genetic gains in many species and enabled the precise selection of key desirable traits. Honeybees have so far missed out on benefits from applying this technology because their genetics is unusual, selective breeding of bees is technically difficult, and, as is the case in most of the world, beekeeping is mainly the domain of hobbyists. NZ has a world-leading, industrialised, export-focused beekeeping industry that has consolidated significantly in recent years. The industry is sufficiently mature and well positioned to extract the benefits of modern genomics-informed breeding and to deploy the results of the research at scale.

The innovation in this project has included:

- leading-edge bee breeding technology, with genetic, genomic and sound-based tests
- key science and technologies for bee breeding
- new ways of monitoring and assessing beehives for breeding purposes
- a new understanding of the bee biology factors that are of importance to bee breeding and bee health
- new technologies for assessing pollination success.

Future Bees New Zealand Ltd was set up as the commercialisation agent for the results of this project. However, this company is not currently operating due to a lack of funds and staff.

9.5.2 Models or tools

The project has developed models and tools to improve bee breeding as noted above.

9.5.3 Publications

The research project resulted in the publication of 15 peer-reviewed and 10 non-peer-reviewed articles. An additional manuscript is under preparation. There were also 20 conference proceedings and 7 keynote presentations throughout the research.

A total of 33 knowledge transfer events were delivered, including workshops, hui, and substantive advice to industry partners and breeding programmes. These activities included end-user workshops on disease traits, training sessions for commercial partners, discussion groups on Varroa control and genetic selection, and advice to Australian and New Zealand bee breeding programmes.

9.5.4 Awards

One of the PhD students working on the project, Georgia Cullen, was given the award for the best student presentation at the International Congress of Genetics in Melbourne in 2023.

Professor Peter Dearden won the Distinguished Researcher Award at the Otago School of Biomedical Sciences[71] and the Genetics Otago Medal in 2023 for sustained excellence in genetics, recognising outstanding achievements and a positive contribution to the University of Otago research.

[71] https://www.otago.ac.nz/news/newsroom/school-of-biomedical-sciences-awards,-2018

9.6 Outcomes

This project has delivered the background science, tools and technologies, and ideas required to establish a modern bee breeding programme in New Zealand. The project has generated new knowledge about fundamental bee biology of importance to breeding programmes, generated the statistical models required to support effective bee breeding, developed new tools and technologies for remote monitoring of bees and integrated that information into operating programmes, developed new knowledge around effective bee pollination, and analysed beekeeper needs in breeding programmes. A spin-off company has been established to deliver world-leading bee breeding advice to industry.

The implementation of the project outcomes is planned to be undertaken by Future Bees NZ Limited, which is also intended to provide advice to beekeeping entities. Two large New Zealand beekeepers engaged with Futures Bees NZ Limited during the course of the project to explore the potential use of the new knowledge and statistical tools that were developed. The outcomes could include increased honeybee-related exports and increased efficiency of pollination services provided by honeybees.

9.6.1 Alignment with government strategic priorities

Honeybees are critical to New Zealand's expanding and high-value seed and honey exports and underpin the production efficiencies of New Zealand's horticulture and forage-based sectors. In order to achieve the Government's Business Growth Agenda export targets, these sectors require a significant increase in their productive capacity. Improvements in New Zealand's Bee stock are therefore of great importance.

9.7 Impacts

9.7.1 Economic impacts

While Future Bees NZ Ltd is not currently operating due to lack of working capital and staff capacity, there is currently no evidence that the underlying IP, technical capability or industry demand for improved bee genetics has lapsed. The pause reflects prevailing market conditions in the honey sector (including oversupply and depressed margins), rather than a failure of the science, tools, or commercial model.

Accordingly, for the purposes of the ex-ante CBA, the halt in operations is treated as temporary and reversible, contingent on modest catalytic funding to support coordination, extension, and reactivation. Without such support, commercial uptake is likely to remain stalled and realised benefits would be significantly diminished – not because the innovation is unviable, but because current industry conditions constrain adoption.

This assessment estimates only a subset of the total economic benefits arising from the Selecting Future Bees project. Quantitative estimates are limited to the value of increased honey production per hive.[72]

Other potential benefits, including reduced disease-related losses, improved pollination outcomes, accelerated uptake of breeding technologies, and wider spillovers to biosecurity resilience and export diversification, are described qualitatively only. These impacts are expected to be significant but have not been monetised due to challenges in attribution, variability in biological outcomes, and limited data availability.

[72] Quantitative estimates are limited to the value of increased honey production per hive as this is the most directly measurable and evidence-based impact with available data to support robust monetisation.

The following section provides context on the honey industry and then focuses on the quantified benefit stream.

Value of increased honey production

New Zealand's beekeeping industry had a period of strong growth based on sales of Mānuka honey prior to 2015, when profitability peaked. Since then, profit margins have declined. Production remained high until 2020 when successive years of excess production led to a decline in the value of honey and heavy discounting of product for export. This led to some beekeepers leaving the industry and/or scaling down production.

For honey to be legally labelled as 'Mānuka honey', it must be predominantly collected from the nectar of Mānuka (*Leptospermum scoparium*) flowers. Mānuka honey contains unique and beneficial compounds. Laboratory testing for these compounds is used to determine the purity and potency of Mānuka honey. In New Zealand the Ministry for Primary Industries enforces a Scientific Regulatory Definition for exported Mānuka honey based on chemical fingerprinting and pollen DNA marker analysis. The introduction of Mānuka authentication testing in 2017 also appears to have had some impact on the outputs and revenues of the industry, but it is too soon to understand the full implications for beekeepers.

Since the detection of Varroa mite in the year 2000 this problem has spread, impacting on production and costs. In addition, a 3.6% decline in industry revenue in 2024-25 was expected as a result of the detection of American Foulbrood in the colonies of one major producer, which forced the beekeeper to destroy hives. However, the prospects for industry growth are now looking better. According to IBISWorld, industry revenue in 2025-26 is expected to reach $453 million.

Honey, and in particular Mānuka honey, is an important export earner for New Zealand. Honey exports from New Zealand peaked at $504 million in 2020 before falling to $419 million in 2022. Mānuka honey comprised 76% of New Zealand's honey exports in 2022. New Zealand has the lowest volume (13,800 tonnes) and the highest value per unit ($US23/kg) of the world's top ten honey exporters[73].

Evidence from the Selecting Future Bees project

Preliminary results from the first 4 years of the project indicate:

- A 9.4% increase in honey production per hive through selective breeding across the first 4 years of the project.
- Disease resistance impacts, which are harder to measure because diseases appear unevenly, but beekeepers are seeing improvements – especially less chalkbrood and some reduction in deformed wing virus (around a 20% drop). These improvements could have significant economic and social benefits, especially for pollination.
- Pollination impacts in the cherry industry through the adoption of standard operating procedures for pollination, with cherry yields increasing by approximately 5% over 2 experimental seasons. This demonstrates the potential for broader pollination benefits across other horticultural sectors.

Broader industry implications

Apiculture New Zealand's target of $1 billion for the value of the honey sector by 2030 would require a growth rate of around 15% per annum. AbacusBio has estimated that the value of genetic improvement to

[73] IBISWorld. (2025.). Beekeeping in New Zealand: Sticky situation—American foulbrood cases have led to hive burning, dampening honey production (Industry Report A0193NZ).

New Zealand beekeepers and landowners would exceed $217 million over 15 years. This did not account for the benefits of disease management or pollination.

The project's funding proposal estimated that, 5 years post-contract, at least 2 new bee breeding companies could be established. It also projected that 50% of commercial bees (500,000 hives) in New Zealand would be developed through breeding pipelines developed by the project. Accelerated uptake of the findings from this project, together with an increase in the number of beehives and a modest increase in the price of honey, would likely make the $1 billion target achievable. The world market for honey is expected to grow with a cumulative average growth rate of 6.4% , reaching $US21 billion in 2028[74] .

In addition to honey, beekeepers produce other bee products including bee pollen, propolis, royal jelly, bee venom and beeswax. Demand for live bees from countries such as Canada is another way in which the sector can gain revenue.

At the same time, increased effectiveness in pollination in horticulture could spread to kiwifruit, apple, pear, legume, seed and berry growers. The impact of varroa mite on feral (unmanaged) bees in New Zealand is reported to have been particularly severe.[75] As a result, there is likely to be an increased need for pollination by bees from managed hives. These impacts are potentially substantial but remain outside the scope of the quantitative analysis presented in this case study.

Methodology for calculating benefits in the CBA

Incremental economic benefits were estimated as the increase in producer surplus arising from higher honey yields, attributable to the adoption of the Selecting Future Bees genetic improvement research outcomes. Because there has been limited uptake of the project outputs to date, the analysis is undertaken on an ex-ante basis. Specifically, the assessment considers the outcome that could reasonably be expected if additional funding were provided to catalyse adoption.

Total incremental honey production was calculated as the product of the number of registered beehives, the proportion of hives adopting the research outcomes, and the incremental yield per hive. For the purposes of this ex-ante assessment, it is assumed that an investment of $0.5 million over the course of a year would materially improve industry participation, enabling uptake to reach 40% of hives over time. This reflects the need for public funding to support coordination and extension activities, and early-stage commercialisation, which are necessary to drive adoption.

The yield uplift was assumed to reach a maximum of 4.50 kg per hive over 15 years[76], with gains in yield over time estimated using a Gompertz curve[77] (see Figure 9.3) to reflect the gradual realisation of biological improvements over successive breeding cycles. Research outcomes uptake was modelled separately using a Gompertz adoption curve (see Figure 9.4), reflecting the typical S-shaped diffusion of new technologies with slow initial uptake, accelerating adoption, and eventual saturation. The effective number of hives benefiting from the research outcomes in each year was therefore determined by the penetration rate implied by this adoption curve.

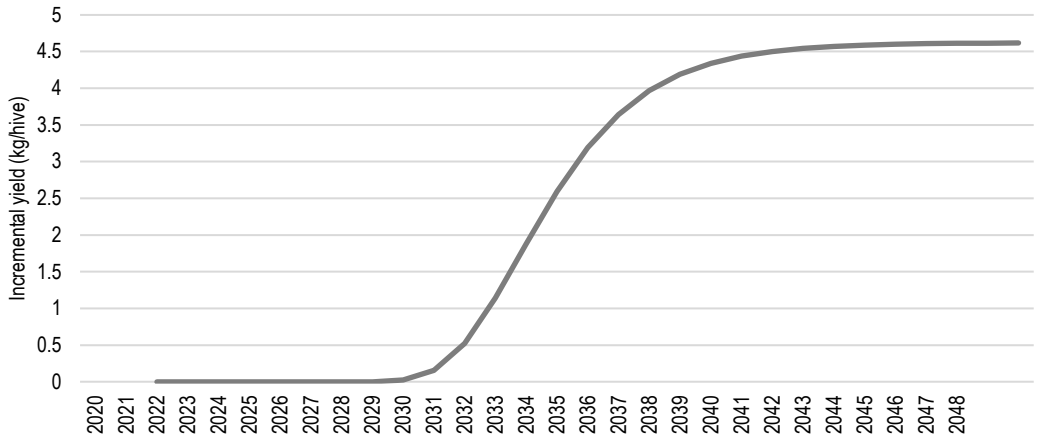
[74] Apiculture New Zealand. (2024*). New Zealand Honey Strategy 2024-2030: Thriving together: Futureproofing New Zealand apiculture (Strategy document)*.

[75] Newstrom-Lloyd LE, (2013), Pollination in New Zealand, in Dymond JR ed. Ecosystem Services in New Zealand – conditions and trends, accessed on 2 January 2026 at

[76] This is based on the assumption that preliminary gains of 9.4 per cent increase in yield will lead to about 15 per cent increase in yield over an evaluation period of 15 years.

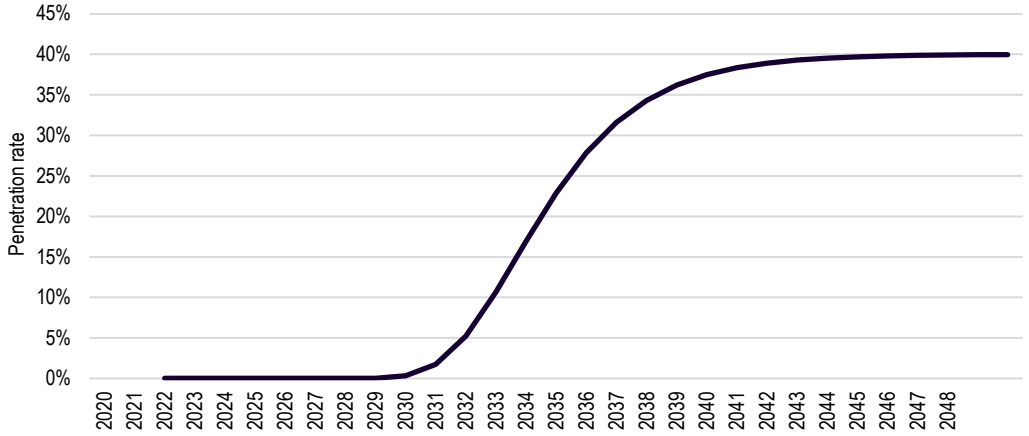
[77] A Gompertz curve is an S-shaped growth curve defined by an exponential decay in relative growth rate over time. It is commonly used to model processes where growth is rapid at first but slows as saturation or system limit is approached, such as market adoption or progressive realisation of genetic improvements.

Figure 9.3 Projected incremental yield



Source: ACIL Allen

Figure 9.4 Projected research outcomes adoption



Source: ACIL Allen

Incremental honey production was allocated across 3 honey categories – monofloral Mānuka, multifloral Mānuka, and non-Mānuka – using export volume shares as a proxy for production volume shares. Export value shares were not used, as price premia for Mānuka honey would otherwise overstate its share of physical production.

For each honey category, incremental producer surplus was estimated using category-specific prices and a 15% net profit before tax applied to incremental honey revenue. The starting point for this assumption is the average net profit before tax of approximately 12%, observed for Northland beekeeping operations over the 2008–2018 period. This margin was uplifted to 15% to reflect the incremental nature of the benefits being assessed. This is because most fixed costs and overheads are already incurred under existing operations, meaning that the additional costs associated with adopting the technology are expected to be limited largely to the use of breeding and selection tools required to access improved bee stock. The higher margin, therefore, reflects the lower marginal cost structure of incremental honey production rather than an assumption of improved whole of hive cluster profitability.

Formally, annual incremental producer surplus was calculated as:

$$\sum_{c}\Big[(\text{Hives} \times \text{Adoption}_{t}) \times (\Delta\text{Yield}_{t}) \times (\text{Production Share}_{c}) \times (\text{Price}_{c}) \times (\text{Net profit before tax})\Big]$$

where both the adoption rate and the yield uplift evolve over time according to Gompertz functions.

This approach provides a transparent and conservative estimate of the incremental economic benefits from increased honey production only, recognising that total project benefits are likely to be substantially larger once broader pollination, biosecurity, and industry resilience impacts are taken into account.

Counterfactual

This project has brought together a combination of scientific, technical, and commercial capabilities to address a significant and systemic challenge facing the New Zealand apiculture sector. In the absence of Endeavour Fund support, it is unlikely that the limited existing research resources would have achieved this project's significant outcomes.

Without the project, improvements in honeybee genetics, disease prediction tools, and pollination optimisation would have occurred, if at all, much more slowly and in a fragmented manner. In particular, the development of statistical breeding tools, remote monitoring technologies, and the establishment of a dedicated commercial entity (Future Bees NZ Ltd) to accelerate uptake would be unlikely under a business-as-usual scenario. As a result, productivity gains, disease-related cost reductions, and pollination benefits would have been significantly delayed or even foregone.

The counterfactual therefore assumes that, without Endeavour Fund support, adoption of advanced bee breeding technologies would have been limited, with industry performance remaining broadly at current productivity and hive loss rates over the evaluation period.

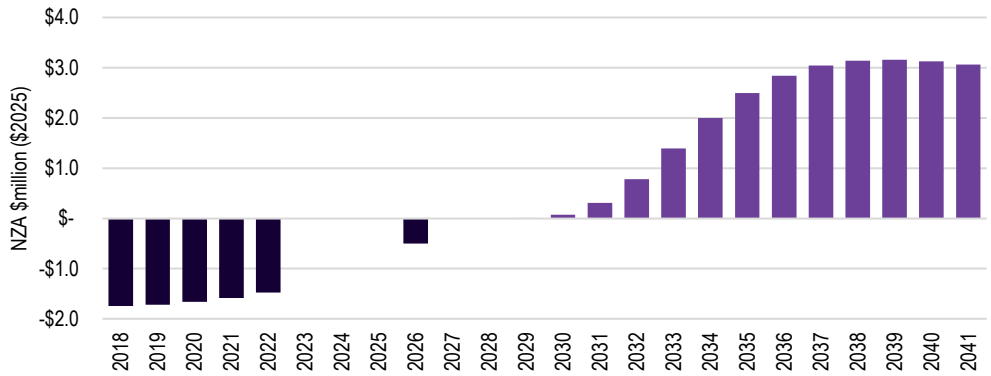
Attribution

For the purpose of this analysis, 95% of both costs and benefits can be attributed to Endeavour Fund, consistent with its proportion of total New Zealand funding for the programme.

9.7.2 Calculation of NPV and BCR

The estimated costs and benefits to New Zealand from the Selecting Future Bees project is shown in the figure below (Figure 9.5), which summarises impacts over the period 2025-2041 in constant 2025 NZD.

Figure 9.5 Costs and benefits to New Zealand from the Selecting Future Bees project 2025-2041 ($NZD million, 2025 dollars)



Source: ACIL Allen

Under the assumptions outlined above, it is estimated that the Selecting Future Bees project would generate $25.44 million (in 2025 dollars) in increased producer surplus due to higher honey production over the evaluation period from 2025-2041. The present value of project costs, comprising research funding and the additional $0.5 million (in 2025 dollars) needed to support extension services and uptake, is estimated at $10.34 million (in 2025 dollars).

In NPV terms, the overall benefit of the project in 2026 using an 4% real discount rate could be $15.10 million (in 2025 dollars).

The benefit-cost ratio (BCR) of the project, calculated as the present value of benefits divided by the present value of costs, is estimated to be 2.46. This means that for every dollar invested in research grants for the Selecting Future Bees project, the Endeavour Fund enabled $2.46 in benefits.

While the quantified benefits relate only to incremental honey production, the project would also yield wider benefits in the long term, particularly for horticulture and pollination-dependent industries. These benefits are expected to be material but are difficult to quantify and are therefore not included in the CBA.

Sensitivity testing

Given the uncertainty associated with many of the assumptions used in the CBA, sensitivity analysis was conducted to assess the sensitivity of the results to substantial changes in the following assumptions:

- discount rate
- assumed market penetration of breeding tools for improved bee stock selection
- attribution to the Endeavour fund.

The results of the sensitivity analysis are presented in Table 9.2. As shown in this table, the BCR:

- increases with:
  - a reduction in the discount rate
- decreases with:
  - an increase in the discount rate
  - a decrease in the assumed market penetration of the breeding tools for improved bee stock selection
  - a decrease in the attribution of the benefits to the Endeavour Fund.

Table 9.2 Sensitivity analysis – impact of sensitivity tests on the economy wide impacts

	NPV ($million)	BCR
Central case	$15.10	2.46
Discount rate		
Decrease from 4% to 2%	$22.44	3.43
Increase from 4% to 8%	$3.81	1.29
Change in assumed market penetration of the breeding tools for improved bee stock selection		
Decrease from 40% to 35%	$12.39	2.26
Attribution to the Endeavour Fund		
Decrease from 95% to 75%	$11.93	2.46

Source: ACIL Allen

9.7.3 Social impacts

Educational impacts

Educational impacts from the project include 2 Master's degrees and the completion of one PhD student. There were also 4 post-doctoral appointments. These roles have supported capacity building in areas such as honeybee genetics, breeding and applied apiculture science.

Beyond formal qualifications, the project has contributed to workforce development and knowledge transfer, with researchers progressing into roles across academia and research organisations, including positions at the University of Melbourne, Plant and Food Research, and the LAVES Institut für Bienenkunde Celle in Germany.

Increased social resilience

The project will increase social resilience among beekeepers. The honeybee industry is dominated by small operators – possibly 9,000. By improving hive health, disease resistance, and productivity through advanced breeding tools and knowledge, the project reduces vulnerability to environmental and market shocks. Access to these technologies, alongside industry support and advisory services, will help beekeepers maintain more stable and sustainable operations over time, strengthening the overall resilience of the apiculture community.

Māori benefits

The involvement of Miere and Tai Tokerau honey and their representation on the project's Industry Advisory Group demonstrates active Māori participation and leadership in research that is relevant to Māori. This supports the intent of Vision Mātauranga by fostering meaningful partnerships and enabling Māori to play a central role in shaping and benefiting from research outcomes.

Additionally, Māori beekeepers could benefit from early-adopter advantages from using improved stocks and technology. It is envisaged that Māori businesses will engage through purchase of elite queens to breed commercial queens. Working with Māori-owned beekeeping businesses has provided a Māori viewpoint on sustainability and guardianship of honeybee stocks. Employment impacts

IBISWorld reports that the beekeeping industry involves around 1,700 employees. This is expected to increase as the number of hives increases. Improved hive productivity may also require greater labour inputs. Growing the pollination role of honeybees from commercial hives is expected to be very important for

the continued existence of some horticultural sectors, where, if wild honeybee numbers were to continue to decline. Maintaining the sustainability of the horticulture sectors is crucial to maintaining the significant number of employees in those sectors.

9.7.4 Other impacts

Collaboration

The project has included collaboration with researchers in Germany at the LAVES Institut für Bienenkunde Celle, as well as with Professor Liz Duncan at the University of Leeds in the United Kingdom on fundamental honeybee biology.

Spillover benefits

All the tools and technologies developed in honeybee are now being deployed in an MBIE-funded project to develop new tools to control invasive and damaging social wasps. The knowledge from the Selecting Future Bees project has been essential for designing and implementing research to develop genetic biocontrol for these pests, which cost the economy $133 million per year.[78]

The knowledge from Selecting Future Bees is also being deployed by Genomics Aotearoa (led by Peter Dearden) to provide up-to-date genomic information to support the ongoing efforts of MPI to eradicate invasive hornets from North Auckland, a pest that in some areas of Europe has destroyed up to 80%[79] of bee hives.

9.8 Potential future impacts

There would appear to be opportunities for an expansion of honey production, especially Mānuka honey and related products. This would need to be accompanied by increased international marketing. There is an opportunity for Future Bees NZ Ltd to provide its services to more beekeepers with Government assistance. This would generate economic benefits to New Zealand.

Expanding the use of managed bees in pollination would generate wider economic benefits across other sectors including horticulture and forage. Selecting Future Bees NZ could also find opportunities to advise beekeepers in other countries, such as Australia.

The consequence of not funding further work to take advantage of the results of this project could be very serious. Varroa mite has devastated the wild bee population in New Zealand, meaning that it is no longer available to pollinate crops and pastures. Honeybees could play an important role in replacing the pollination activities of wild bees. However, for this to happen, the results of this project (and other related work) to manage varroa mite and improve bee performance in managed hives will be critical. What is at risk here are New Zealand horticulture exports (including wine) valued at more than $8 billion per annum.

Stakeholders consulted in the preparation of this case study have noted the challenges that New Zealand beekeepers have been and continue to face. These stakeholder problems were particularly clearly explained by the following who said:

> *"Genetic diversity is essential for a robust healthy bee population. A key finding of the research (that was communicated well to beekeepers) is that there is a high level of genetic diversity within the NZ*

[78] Palmer S, Dearden PK, Mercier OR, King-Hunt A, Lester PJ. Gene drive and RNAi technologies: a bio-cultural review of next-generation tools for pest wasp management in New Zealand. J R Soc N Z. 2021 Oct 14;52(5):508-525. doi: 10.1080/03036758.2021.1985531. PMID: 39440191; PMCID: PMC11485957.

[79] Lester, P. 2026. *The yellow-legged hornet eradication is on track – but the next few months are crucial*. The Conversation.

population such that beekeepers can manage their populations to ensure genetic diversity within their own businesses. This means beekeepers have the toolbox to manage their operations. The challenge, however, is not the quality of the research, rather collapse of commercial demand. Beekeepers are simply not receiving sufficient returns to justify investing in the outcomes of this research. In essence, the toolbox is available, but without strong market demand, there is little incentive or capacity to put those tools to work."

Source: Peter Fennessy, Ex-managing director, AbacusBio

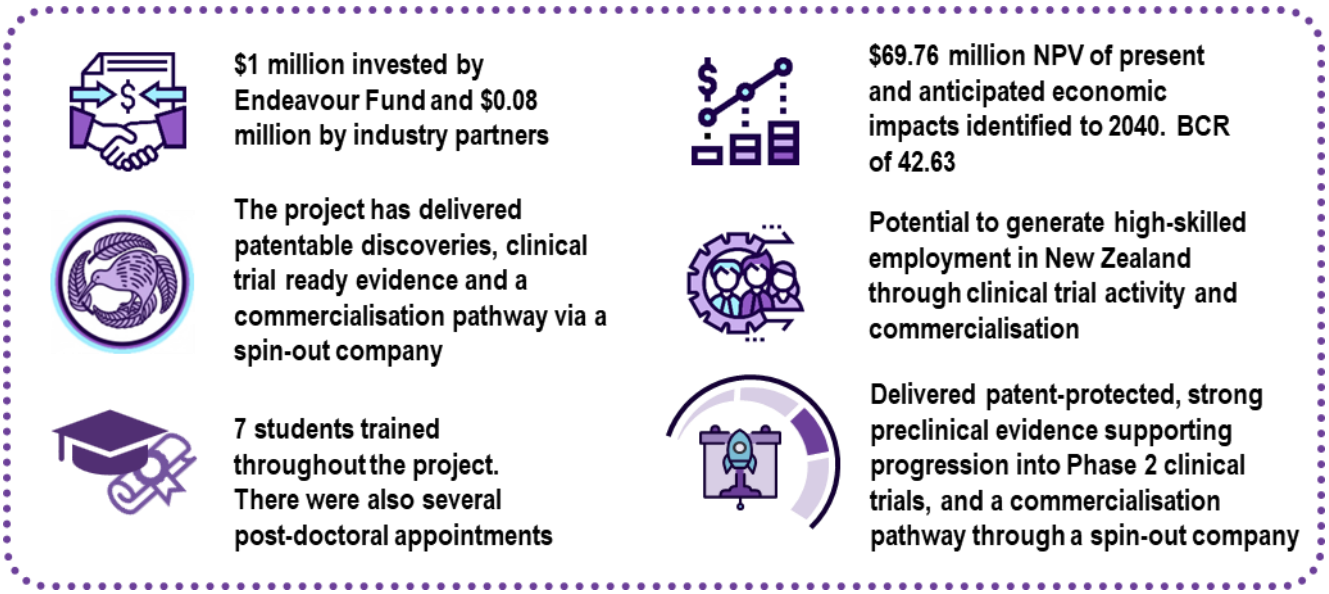
"The biggest improvement will come from greater information sharing, increased collaboration, and more collective efforts in education and market development. Ideally, this leads to better financial outcomes, which in turn supports improved health and genetic profiling at the source. All of these factors are interconnected. Unfortunately, at the time [of completion], the Future of Bees project was stymied because the industry was focused on immediate concerns, such as a massive oversupply of product and markets unwilling to absorb it."

Source: A significant industry stakeholder

In the absence of further investment to ensure the progressive take up of the results of the project, the likely return on investment for this project could be greatly diminished.

10 Case Study 4: Remyelination in MS

Remyelination in MS focused on repurposing nalfurafine and novel compounds to promote nerve repair and remyelination in multiple sclerosis, paving the way for a first-ever recovery therapy. The project generated strong preclinical efficacy data, secured multiple international patents, and established a new chemical entity pipeline to identify next-generation candidates. The spin-out company, Rekover Therapeutics Ltd, has been formed to commercialise the technology and has received ethics approval in Australia and New Zealand for a Phase 2 clinical trial, with capital raising underway. The pathway to impact depends on successful clinical progression, followed by licensing or partnership with a pharmaceutical company, which could deliver significant royalty revenues and reduce the long-term health and social costs of MS.

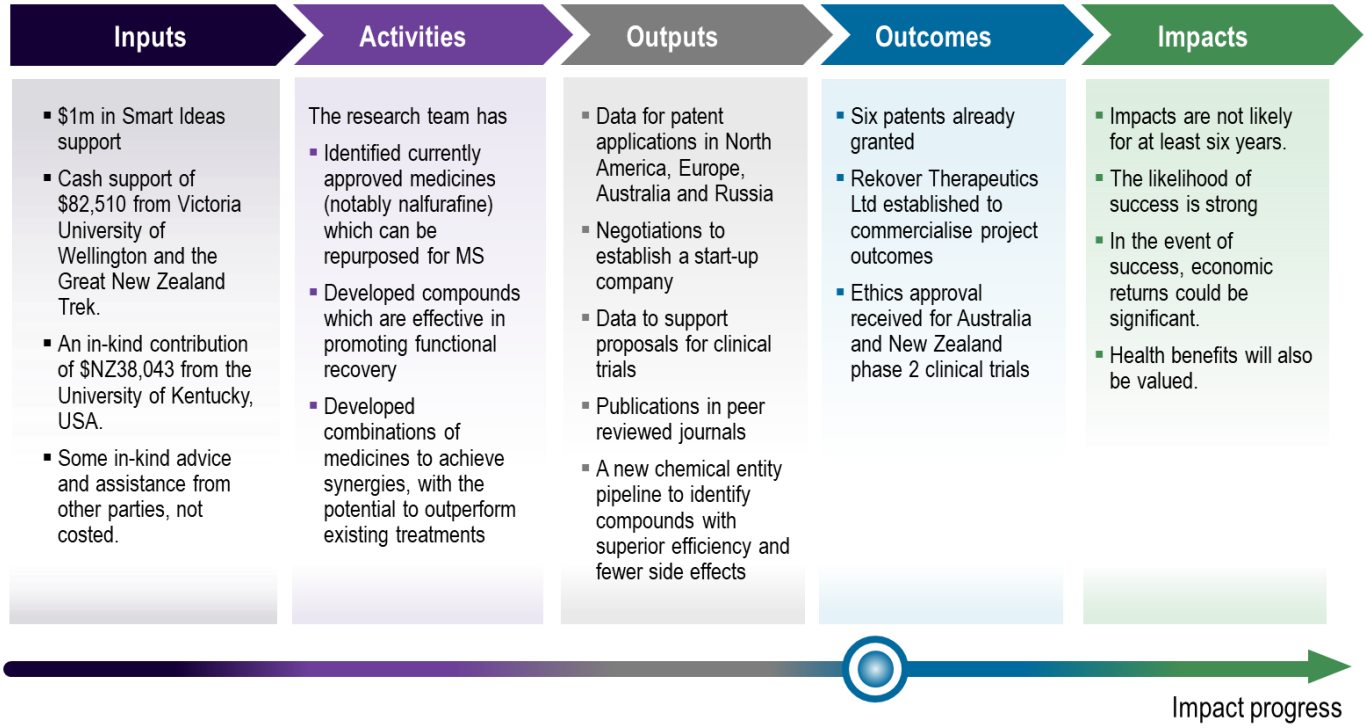


10.1 Case study framework

The framework used to evaluate and demonstrate the impact and value of Endeavour funded research into Remyelination in multiple sclerosis is provided in Figure 10.1. The framework is based on best practice evaluation models and has been used by ACIL Allen to assess a large number of research organisations and funding mechanisms in Australasia.[80]

[80] The approach is based on that outlined in the CSIRO Impact Evaluation Guide. See https://www.csiro.au/~/media/About/Files/Our-impact-framework/CSIROImpactEvaluationGuide_Nov2015_WEB.pdf?la=en&hash=B351D24FB3CE02CB34FB859F2C34AA3940EE6D1F.

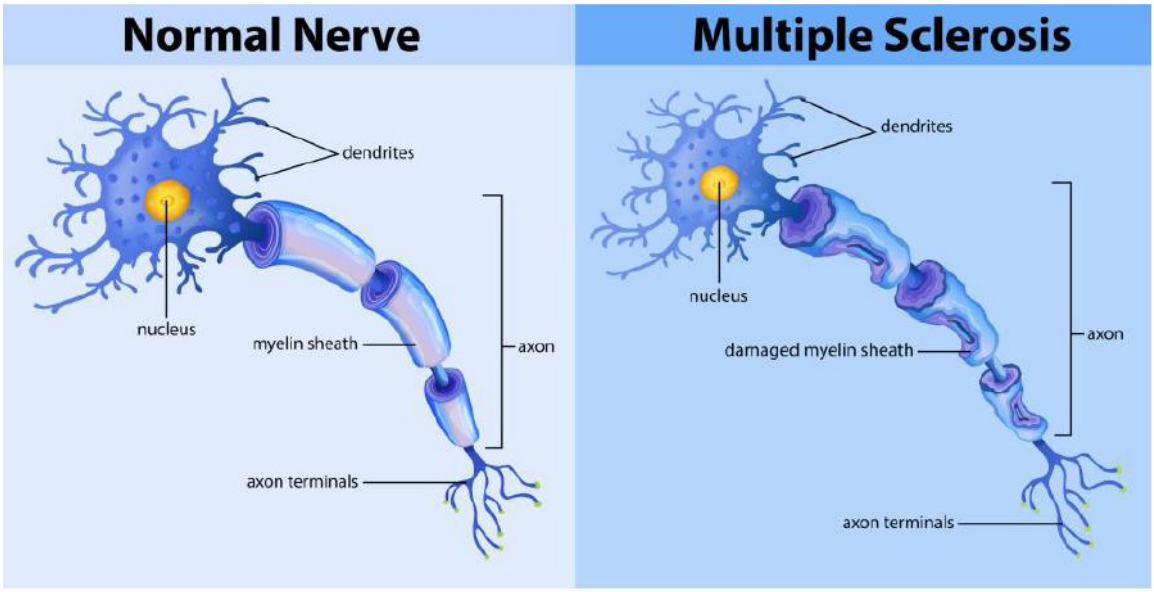
Figure 10.1 Remyelination in multiple sclerosis – Impact Framework Diagram



Source: ACIL Allen

10.2 Background

Figure 10.2 Multiple sclerosis



Source: blurringmedia. 2018. Normal nerve and multiple sclerosis [Stock illustration]. iStock.

Multiple sclerosis (MS) is a progressive neuroinflammatory disease. MS is the leading cause of nontraumatic neurologic disability among young adults. The global incidence and prevalence of MS is rising, with

2.8 million people worldwide living with MS in 2020 compared with 2.3 million in 2013.[81]The USA is among the countries with the highest prevalence, with 288 MS cases per 100,000. There are over 4,000 people currently with MS in New Zealand.[82]

The first disease-modifying therapy (DMT) was approved for the treatment of MS in 1993.[83] In the last decade, several newer high efficacy DMTs have significantly transformed the management of MS. However, their affordability remains a challenge, posing a considerable economic burden.

This project aimed to develop the first treatment to promote repair and recovery in MS. Over one-third of people with MS suffer from moderate to severe disability characterised by impaired vision, coordination, and paralysis, and there is no cure. Disease-modifying drugs are available, but they are only effective in one of the 3 major forms of MS, and while they can reduce the immune-mediated damage, they do not promote repair.

The research project sought to develop urgently needed therapies that target repair and enable the remyelination of the nerves in MS. The researchers discovered that activating a specific neurological pathway in an experimental model leads to full recovery from MS disease in a proportion of animals. The project team also:

— identified currently approved medicines (particularly nalfurafine), which targets this pathway and can be repurposed for MS

— discovered novel compounds, developed by the research team, which are effective at promoting functional recovery.

The project team has characterised the disease-modifying effects of the repurposed and novel compounds in preparation for clinical development. The project team has also investigated whether greater benefit can be gained by targeting 2 different neurological pathways as well as combining the therapeutics to promote repair with current immune-targeting MS drugs. The ultimate aim of this research is to deliver a new, and first-ever treatment to enable functional recovery in people with MS.

10.3 Inputs

The Endeavour Fund provided $999,999 (ex GST) in support under Smart Ideas funding stream. Cash contributions totalling $44,467 was provided by the Victoria University of Wellington and Great New Zealand Trek. The University of Kentucky provided a $NZ38,043 in-kind contribution (see Table 10.1). Some other parties and research organisations also provided advice and in-kind support that has not been able to be quantified.

The research for this project was led by Professor Anne La Flamme and Associate Professor Bronwyn Kivell, from Victoria University of Wellington's School of Biological Sciences, assisted by Lisa Denny, Afnan Al Abadey, Dr Katharina Robichon, and Dr Nikki Templeton. Working with them was Professor Thomas Prisinzano from the University of Kentucky, USA.

The project team engaged with potential end-users including key opinion leaders, experts in MS drug development, pharmaceutical companies and potential investors for the spin-off company Rekover Therapeutics.

[81] Multiple Sclerosis International Federation. 2020. *Atlas of MS, 3rd Edition: Epidemiology Report*. https://www.msif.org/wp-content/uploads/2020/10/Atlas-3rd-Edition-Epidemiology-report-EN-updated-30-9-20.pdf

[82] New Zealand Brain Research Institute. *Multiple Sclerosis Research Group.* https://www.nzbri.org/Labs/ms/

[83] Hartung DM, Bourdette D. Addressing the Rising Prices of Disease-Modifying Therapies for Multiple Sclerosis. *JAMA Neurol*. 2019;76(11):1285–1287. doi:10.1001/jamaneurol.2019.2445

Table 10.1 Support for the Remyelination in multiple sclerosis project

Contributor/type of support	2018-19	2019-20	2020-21
Cash			
Endeavour Fund	$333,333	$333,333	$333,333
Victoria University of Wellington			$36,605
Great New Zealand Trek			$7,862
Total (cash)	$333,333	$333,333	$377,800
In-kind			
University of Kentucky	$12,681	$12,681	$12,681
Total (in-kind)	$12,681	$12,681	$12,681
Grand Total	$346,014	$346,014	$390,481

Source: ACIL Allen from project final and annual reports.

The inputs phase reflects only the funding allocated to the initial research stage of the project. Since 2021, the project has continued to advance, attracting additional investors and receiving direct support in research and IP management from teams at Victoria University of Wellington. This includes the ongoing contributions of Professor Anne La Flamme and Professor Bronwyn Kivell, further investment in IP management from Victoria Link Limited (a wholly owned subsidiary of Victoria University of Wellington), and new funding secured through a convertible note.

10.4 Activities

The project team has undertaken research on the potential of the drug nalfurafine to slow the accumulation of disability in MS. Nalfurafine has been used clinically for years in Japan and South Korea to treat various non-MS conditions and has been shown to be safe and well tolerated.

The research team has demonstrated that the combined use of the optimal and sub-optimal stand-alone doses of one drug led to distinct disease modifying activities, indicating that the dose combinations are specific and novel.

Building on these findings, the team also examined how the performance of this drug could be enhanced when used in combination with another compound. The researchers have shown that when nalfurafine and certain other compounds are used together, they can provide enhanced benefit. In an experimental model, these combinations were able to restore function lost through MS.

Nalfurafine has also been shown to substantially improve the therapeutic efficacy of a current MS drug, fingolimod. These research outcomes will be used when designing clinical trials.

In 2020, Professor La Flamme and Associate Professor Kivell co-founded a spin-out company, Rekover Therapeutics, with investment from the New Zealand Innovation Booster Fund, a partnership between the University's commercialisation arm, Wellington UniVentures, and Booster Financial Services.

10.5 Outputs

10.5.1 Patents

Patents have been filed and prosecuted in North America, Europe, Australia, New Zealand and Russia. As of February 2026, only the New Zealand and Canada patents remain pending, with the remaining jurisdictions all granted.

10.5.2 Innovation/commercialisation

Rekover Therapeutics Ltd has been established to commercialise the results of this project, with Victoria Link Limited, a wholly owned subsidiary of Victoria University of Wellington, holding shares. Following completion of the Smart Ideas project, funding for commercialisation of the Remyelination in multiple sclerosis project has come from the Ministry of Business, Innovation and Employment, the Neurological Foundation of New Zealand, the Health Research Council of New Zealand, the Great New Zealand Trek, the Kate Parsonson Scholarship, the Wellington Medical Research Foundation, and the National Institute on Drug Abuse.

Currently, Rekover Therapeutics is in the process of raising capital for a Phase 2 clinical trial. Ethics approval for this trial has been received in Australia and New Zealand.

10.5.3 Models or tools

Using the knowledge gained from this project, the team has built a new chemical entity pipeline to better identify and develop other compounds with superior efficiency, fewer side effects and wider clinical applications.

10.5.4 Publications

The research project has led to the publication of 4 significant peer reviewed articles.

10.5.5 Awards

— Publication of the Year Award, Clinical & Translational Immunology — an award by the Australian and New Zealand Society for Immunology (CTI) and Wiley, and recognises the best article in Clinical & Translational Immunology or Immunology & Cell Biology (ICB) journals, for Denny L, Al Abadey A, Robichon K, Templeton N, Prisinzano TE, Kivell B, La Flamme AC, 2021, Nalfurafine reduces neuroinflammation and drives remyelination in models of CNS demyelinating disease, Clin Trans Immunol. 10:e1234.

— Dr Katharina Robichon — awarded an MBIE Whitinga Fellowship for excellent early career researchers

— Best of Clinical & Translational Immunology Session ASI 2024: for Robichon K, Bibi R, Kiernan M, Denny L, Prisinzano TE, Kivell BM, La Flamme AC, 2023, Enhanced and complementary benefits of a nalfurafine and fingolimod combination to treat immune-driven demyelination, Clin Trans Immunol. 12:e1480.

— Dr Katharina Robichon, Career Advancement Award 2024. Australian and New Zealand Society for Immunology.

10.6 Outcomes

Outcomes from the project include:

— publication of findings reporting the efficacy of a stand-alone therapeutic at promoting remyelination in 2 experimental models of multiple sclerosis

— a PhD degree was awarded to Lisa Denny for her research investigating the mechanisms by which the remyelinating therapy promotes remyelination and reduces neuroinflammatory disease

— a PhD degree was awarded to Sven Sondhauss for his research investigating the pharmacology of nalfurafine and its mechanism of action in promoting remyelination

— ethics approval has been received from the New Zealand and Australian Human Ethics Committees for REVIVE, a phase 2 randomised, double-blind, placebo-controlled clinical trial to evaluate the stand-alone remyelinating therapeutic in multiple sclerosis
— data packages have been prepared for 2 provisional patent applications
— a new chemical entity platform has been developed for the synthesis, screening and identification of candidates for commercialisation in clinical applications.

10.7 Impacts

10.7.1 Economic impacts

Endeavour Fund investment in projects such as this one can potentially pay significant dividends for New Zealand. This analysis estimates the economic benefits of the MS research programme using 2 complementary frameworks:

— a licensing-based framework, capturing potential royalty income from commercialisation
— an avoided social cost framework, capturing reductions in the economic burden of MS in New Zealand due to improved health outcomes.

If a treatment arising from this research is successfully commercialised and adopted economic benefits to New Zealand are expected to arise from:

— ongoing royalty income
— avoided social costs associated with reduced MS severity.

All projected revenues and avoided costs are expressed in real 2025 New Zealand Dollars and discounted using a real discount rate to estimate Net Present Values (NPV).

ACIL Allen has estimated the economic impact estimates based on conservative assumptions, informed by the available literature where possible. Given the early stage of development, with Phase 2 trials yet to be undertaken, these assumptions are intentionally conservative. As such, the actual returns on investment may be substantially higher than projected.

Ongoing royalty income

Annual royalty income is estimated based on projected global sales of nalfurafine.

Estimating global sales

Global demand is proxied using worldwide MS prevalence. Prevalence is extrapolated to 2040 using historical growth from approximately 2.3 million people in 2013 to 2.8 million in 2020[84], equivalent to an annual growth rate of around 3%.

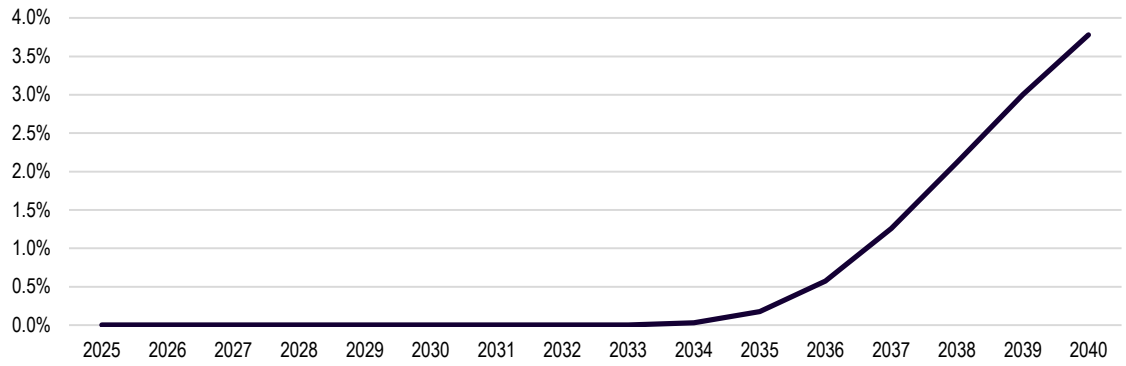
A target population is defined by restricting treatment eligibility to individuals with mild and moderate MS, corresponding to Expanded Disability Status Scale (EDSS) score of ≤6. The EDSS is a widely used clinical measure of disability in MS, quantifying impairment in MS and monitoring changes in the level of impairment over time.[85] Restricting eligibility reflects a conservative assumption that neurorepair therapies are more

[84] Multiple Sclerosis International Federation. 2020. *Atlas of MS, 3rd Edition: Epidemiology Report*. https://www.msif.org/wp-content/uploads/2020/10/Atlas-3rd-Edition-Epidemiology-report-EN-updated-30-9-20.pdf
[85] New Zealand Institute of Economic Research. *Multiple sclerosis. Assessing the social and economic burden. 2020.* https://www.msnz.org.nz/wp-content/uploads/2025/09/Economic-burden-of-MS-2021.pdf

likely to be effective in earlier disease stages, while reversing advanced disability is uncertain. Based on New Zealand prevalence data, approximately 60% of individuals with MS fall within this range.

Treatment uptake is modelled using a Gompertz adoption curve, reaching approximately 4% of the eligible ***global*** population by 2040. The Gompertz function is widely used in technology and pharmaceutical forecasting to represent gradual uptake, accelerating growth during early adoption, and eventual stabilisation as the product approaches maturity. This is a conservative estimate recognising that adoption is likely to occur gradually as drug uptake expands from North America to Europe.

Figure 10.3 Uptake by MS patients



Source: ACIL Allen

Pricing assumptions

The annual price of nalfurafine is assumed to be a proportion of the cost of existing disease-modifying therapies (DMTs). Specifically, a price equal to 50% of the annual cost of fingolimod has been assumed. A weighted global price has been estimated using regional market shares, with United States pricing dominating the average, consistent with the fact that the majority of global MS drug sales occur in the US market.

The reference price for fingolimod is based on current pricing, rather than generic pricing, as this more appropriately reflects the pricing benchmark for patent-protected DMTs at market entry. The 50% discount applied to fingolimod's price is a deliberately conservative assumption. While new DMTs often enter the market at price parity to existing patent-protected therapies, ACIL Allen has priced nalfurafine below this benchmark to reflect uncertainty associated with the potential positioning in the treatment landscape. As such, this assumption is likely to underestimate the potential commercial price of nalfurafine.

All prices are expressed in 2025 New Zealand Dollars.

Royalty calculation

Annual royalty income is calculated by applying:

— a conservative royalty rate of 8%[86]

— a 30% probability of success from Phase 2 to commercialisation[87]

— New Zealand's ownership share in the intellectual property

[86] Licensing Executives Society International. 2017. *Effective Royalty Rates in Biopharma Alliances: What They Are & Why Use Them In Negotiations.* https://lesi.org/article-of-the-month/effective-royalty-rates-in-biopharma-alliances-what-they-are-why-use-them-in-negotiations/

[87] Inderes. 2024. *Probabilities of success in drug development*. https://www.inderes.dk/en/articles/probabilities-of-success-in-drug-development

— confidence share of 50%.

This ensures that *only the share of benefits accruing to New Zealand* are captured.

Annual royalty income is therefore calculated as:

$$Population\ eligible\ for\ treatment \times Treatment\ uptake \times Drug\ price \times Royalty\ rate \times Probability\ of\ success \times NZ\ ownership\ share \times confidence\ share$$

The resulting annual royalty income benefit is expressed in 2025 New Zealand dollars and discounted to estimate the NPV attributable to New Zealand.

The assumed royalty rate reflects the expectation that, following a successful Phase 2 outcome, the asset could be licensed to a partner responsible for Phase 3 development and subsequent commercialisation. Based on published analyses of biopharma licensing agreements, a royalty rate of 8% is consistent with reported effective royalty rate ranges for Phase I/II-stage programs. This assumption reflects development risk, while remaining conservative given the current stage of development, and may therefore underestimate the true royalty achievable following further clinical de-risking.

There is uncertainty regarding the commercialisation pathway for nalfurafine. While it may be licensed to a third party following a successful Phase 2 trial, it could alternatively progress to Phase 3 prior to licensing in order to secure more favourable commercial terms, including higher royalty rates. Capital is currently being raised to support Phase 2 development. As additional capital is raised, dilution of the current majority New Zealand ownership is plausible, where investment is sourced internationally.

Given these uncertainties – both in relation to the timing and structure of commercialisation, and the potential dilution of New Zealand ownership – a conservative confidence share of 50% has been applied to the annual royalty income benefit. This adjustment reflects the likelihood that a portion of future economic benefits may accrue to non-New Zealand investors, and that realised returns may differ from projected returns.

Avoided social costs

MS imposes a significant and wide-ranging economic burden on New Zealand. In 2020, Multiple Sclerosis New Zealand commissioned the New Zealand Institute of Economic Research (NZIER) to assess the social and economic costs of the disease.[88] The study estimated that, in 2021, the total economic burden of MS amounted to approximately $266.3 million, excluding the cost of MS-related mortality.

This burden reflects a combination of healthcare system costs, informal care, productivity losses, and reductions in health-related quality of life. Health system costs alone were estimated at $130.5 million in 2021, equivalent to an average annual cost of approximately $31,600 per person with MS. In addition, the total cost associated with reduced health quality (measured using quality-adjusted life years, or QALYs) was estimated at $26.3 million.

MS has a disproportionate economic impact because it primarily affects individuals during their prime working and caregiving years, typically between the ages of 25 and 50. As a result, the disease can significantly disrupt labour force participation, household financial stability, and long-term economic outcomes. These impacts are often not fully captured in traditional funding decisions.

The NZIER analysis also highlights that costs increase significantly with disease severity, reinforcing the importance of early intervention and access to effective treatments. Interventions that delay or prevent progression to higher disability states therefore have the potential to generate substantial economic benefits.

[88] New Zealand Institute of Economic Research. *Multiple sclerosis. Assessing the social and economic burden. 2020.* https://www.msnz.org.nz/wp-content/uploads/2025/09/Economic-burden-of-MS-2021.pdf

This evidence provides the foundation for the avoided cost framework applied in this analysis, which estimates the economic value of reducing disease progression among people with MS in New Zealand.

If successfully commercialised, the drug is expected to reduce disease progression, generating economic benefits through avoided costs in New Zealand. These include reductions in:

— healthcare system costs
— informal care costs
— productivity losses (employment impacts)
— health-related quality of life losses.

Cost estimation by disease severity

Cost estimates are based on the NZIER study on the economic burden of MS in New Zealand.[89] Costs are reported either by severity category or by EDSS score. To ensure consistency, EDSS scores are mapped to severity bands based on the literature[90]:

— Mild (EDSS 0-3)
— Moderate (EDSS 4-6)
— Severe (EDSS 7+).

Healthcare and informal costs are directly available by severity. Productivity losses are estimated using employment rates by EDSS score, aggregated to severity bands and applied to average earnings for individuals with MS. Health-related quality of life losses are similarly averaged across EDSS scores within each severity band.

Total annual costs per person are calculated by summing these components within each severity category.

Valuing avoided progression

In this analysis, economic benefits arise when progression to a more severe disease category is avoided. Specifically:

— avoiding progression from mild to moderate
— avoiding progression from moderate to severe

The value of avoided progression is calculated as the difference in total annual costs between severity levels.

In the baseline scenario (i.e. in the absence of nalfurafine as a treatment drug):

— 10% of individuals with mild MS progress to moderate each year
— 12% of individuals with moderate MS progress to severe each year.

These transition rates are informed by clinical evidence indicating that MS progression occurs gradually over long-time horizons. Longitudinal studies suggest that the median time to reach EDSS scores of 2, 3, 4, 5 and 6 is approximately 4.8, 15.1, 28.2, 31.2 and 32.4 years respectively, highlighting that progression between disability states typically occurs over decades rather than within short timeframes.[91]

[89] New Zealand Institute of Economic Research. *Multiple sclerosis. Assessing the social and economic burden. 2020.* https://www.msnz.org.nz/wp-content/uploads/2025/09/Economic-burden-of-MS-2021.pdf

[90] University of Tasmania, Menzies Institute of Medical Research. 2021. *Health Economic Impact of Multiple Sclerosis in Australia in 2021.* p 15. *https://www.msaustralia.org.au/wp-content/uploads/2023/02/health-economic-impact-of-multiple-sclerosis-in-australia-in-2021_final.pdf*

[91] Zurawski, J et al. 2019. *Time between expanded disability status scale (EDSS) scores.* Multiple Sclerosis and Related Disorders, Volume 30, 2019. https://doi.org/10.1016/j.msard.2019.02.007.

Progression is also heterogeneous across the EDSS scale. Transitions between EDSS 4 and 6 occur more rapidly than transitions within earlier (EDSS 0-3) or later stages (EDSS 6-8). Importantly, variation in disease progression also occurs within severity bands, where individuals may experience worsening disability and associated costs without transitioning to a higher severity category. The use of modest annual transition probabilities in this high-level Cost Benefit Analysis (CBA) therefore reflects both the slow and variable nature of MS progression across and within severity states.

Given the limited evidence to support a population-level treatment effect, the intervention is conservatively assumed to reduce the probability of progression of MS by 40%. This reflects the potential for remyelination therapies to slow disability accumulation, while recognising that treatment response is likely to vary across individuals and that not all patients may experience a meaningful benefit.

An expected value approach is used to estimate benefits. Rather than applying benefits only to individuals who progress, the model applies an average risk adjusted benefit across all treated individuals, reflecting the reduced probability of progression.

Expected benefit per person is calculated as:

$$Baseline\ progression\ probability \times Treatment\ effect \times Cost\ of\ progression\ avoided$$

Adjustment for within-state benefits

Two types of benefits may arise from treatment:

— avoiding progression to a higher severity category

— slower progression within a given severity category.

As cost data are available only at aggregated severity levels, the model does not explicitly capture within-state improvements. To account for these within-state (but unobserved) benefits, a conservative uplift factor of 20% is applied to expected benefits.

Net benefit per person

Nalfurafine is assumed to be used as an adjunct therapy. Therefore, drug costs are applied to all treated individuals. The annual cost of nalfurafine is assumed to be 30% of the cost of fingolimod.

Net benefit per person is calculated as:

$$Adjusted\ expected\ benefit - Drug\ cost$$

Scaling to population

Total benefits are estimated by applying the net benefit per person to the treated population. The treated population is calculated by:

— projecting MS prevalence in New Zealand to 2040 using historical growth rates (approximately 1.4% annually)

— allocating the population across severity bands based on EDSS distributions

— applying treatment uptake rates to individuals in the mild and moderate categories.

Total avoided costs are calculated as:

$$Treated\ population \times Net\ benefit\ per\ person \times Probability\ of\ success$$

The resulting avoided social cost benefit is expressed in 2025 New Zealand dollars and discounted to estimate the NPV flowing to New Zealand.

Unquantified benefits

In addition to the quantified impacts, the programme is expected to generate a range of additional economic and social benefits that are not explicitly modelled in this analysis.

In particular, progression to Phase 2 clinical trials would generate direct benefits for trial participants, including potential early access to innovative treatment options and associated health improvements. Clinical trial activity would also contribute to economic activity in New Zealand through increased demand for specialised labour, clinical services, and supporting infrastructure.

These impacts may include employment generation, capability building within the clinical research sector, and broader spillover effects such as knowledge transfer and strengthening of New Zealand's position in global life sciences research.

Due to the high-level nature of this CBA and the absence of detailed information on trial design, scale, and location, these benefits have not been quantified. As a result, the estimated economic impacts presented in this analysis are likely to understate the full value of the project.

Counterfactual

This project has applied leading scientific, capabilities to address a significant health problem worldwide. In the absence of Endeavour Fund support, it is unlikely that the limited existing research resources would have achieved this project's significant outcomes.

Attribution

For the purposes of this analysis, 96% of the estimated benefits are attributed to Endeavour Smart Ideas funding. This reflects its share of total New Zealand public funding for the project and ensures that attribution is aligned with the proportion of domestic investment.

Both costs and benefits are restricted to those accruing to New Zealand. Costs include only funding contributed by New Zealand sources, while benefits exclude any share flowing to international investors (e.g. repatriated profits). Attribution to the Endeavour Fund is therefore based on its share of total New Zealand funding, ensuring consistency between the scope of costs and benefits.

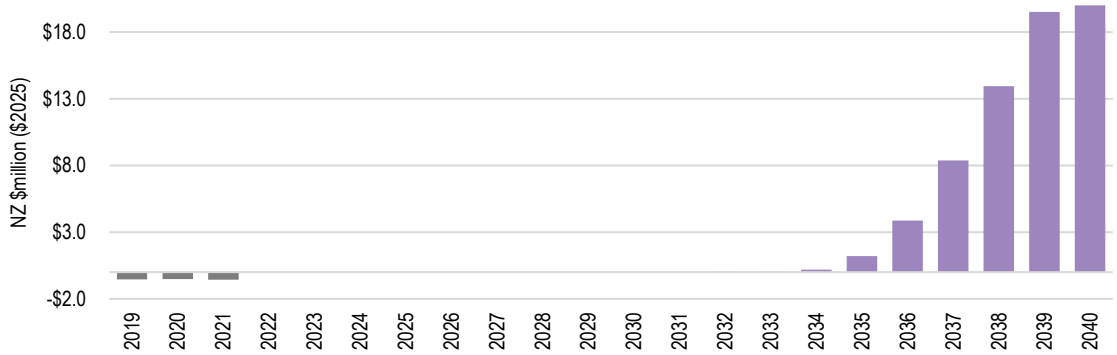
All estimated benefits are further risk-adjusted to reflect the probability of technical and commercial success from the current stage of development, recognising the high attrition rates in clinical trials.

This approach ensures that the results reflect the benefits to New Zealand attributable to Endeavour Fund-supported research, while appropriately accounting for attribution, uncertainty, and the domestic economic scope of the analysis.

10.7.2 Calculation of NPV and BCR

The estimated costs and benefits to New Zealand from the Remyelination in the MS project is shown in the figure below. It summarises the impacts over the period 2025-2040 in constant 2025 dollars.

Figure 10.4 Costs and benefits to New Zealand from remyelination in multiple sclerosis



Source: ACIL Allen

Under the assumptions outlined above, it is estimated that the MS Remyelination project would generate $71.43 million (in 2025 dollars) in licensing fees over the evaluation period from 2025-2040 due to sale of the nalfurafine as a premium product in overseas markets and avoided social costs for the New Zealand economy due to reduced disease progression of MS patients in New Zealand. The present value of project costs, comprising research funding is $1.68 million (in 2025 dollars).

In NPV terms, the overall benefit of the project in 2026 using an 4% real discount rate could be $69.76 million (in 2025 dollars).

The benefit-cost ratio (BCR) of the project, obtained by dividing the present value of benefits by the present value of costs, is estimated to be 42.63. This means that, for every dollar in research grants invested in the Multiple Sclerosis project, the Endeavour Fund enabled $42.63 in benefits to New Zealand.

While the estimated BCR for the project is comparatively higher than the BCRs calculated for the other case studies, it is broadly consistent with the range typically reported for investment in pharmaceuticals this far advanced in clinical trials.

Sensitivity testing

Given the uncertainty associated with many of the assumptions used in the CBA, sensitivity analysis was conducted to assess the sensitivity of the results to substantial changes in the following assumptions:

- discount rate
- confidence share.

The results of the sensitivity analysis are presented in Table 10.2. As shown in this table, the BCR:

- increases with:
  - a reduction in the discount rate
  - an increase in confidence share
- decreases with:
  - an increase in the discount rate
  - a decrease in confidence share.

Table 10.2 Sensitivity analysis – impact of sensitivity tests on the economy wide impacts

	NPV ($million)	BCR
Central case	$69.76	42.63
Discount rate		
Decrease from 4% to 2%	$89.89	61.26
Increase from 4% to 8%	$42.25	21.10
Confidence share		
Decrease from 50% to 25%	$33.89	21.23
Increase from 50% to 75%	$105.63	64.04

Source: ACIL Allen

10.7.3 Social impacts

Educational impacts

Educational impacts from the project include 2 Masters degrees and 5 PhD student theses completed. There were also several post-doctoral appointments.

Māori benefits

As noted above Māori sufferers of MS will benefit if the outcomes of this project are adopted.

Employment impacts

There are possible future employment impacts in New Zealand for Rekover Therapeutics.

10.7.4 Other impacts

Collaboration

Collaboration with the University of Kentucky, USA as noted above.

10.7.5 Potential future impacts

If the treatment approach developed through this project is successful in progressing through clinical trials and obtaining regulatory approval, it has the potential to deliver substantial long-term economic and health benefits.

Following successful Phase 2 outcomes, the project could advance through several commercialisation pathways. These may include licensing the intellectual property to an established pharmaceutical company, entering into co-development partnerships, or pursuing an outright sale to a pharmaceutical company, with the acquirer taking responsibility for the remaining development and commercialisation stages. The optimal pathway would depend on factors such as clinical trial results, regulatory requirements, manufacturing capabilities, and overall market positioning.

Bringing a new therapy to market involves additional stages, including large-scale clinical trials, regulatory approval processes, pricing and reimbursement negotiations, and market access strategies across different

jurisdictions. Each of these steps introduces uncertainty, cost, and time delays, but also creates opportunities for value generation through investment, employment, and industry development.

If successfully commercialised, the treatment could achieve meaningful global uptake, particularly if it demonstrates effectiveness as an adjunct therapy for individuals with mild to moderate MS. Over time, this could result in sustained revenue streams, broader access to treatment, and cumulative reductions in the global burden of MS.

In addition, successful development would strengthen New Zealand's position in biomedical research and commercialisation, supporting capability development, attracting further investment, and generating spillover benefits across the life sciences sector.

Given these uncertainties and the early stage of development, these impacts are not explicitly quantified in this analysis. However, they represent important upside potential beyond the quantified benefits presented in the cost benefit framework.

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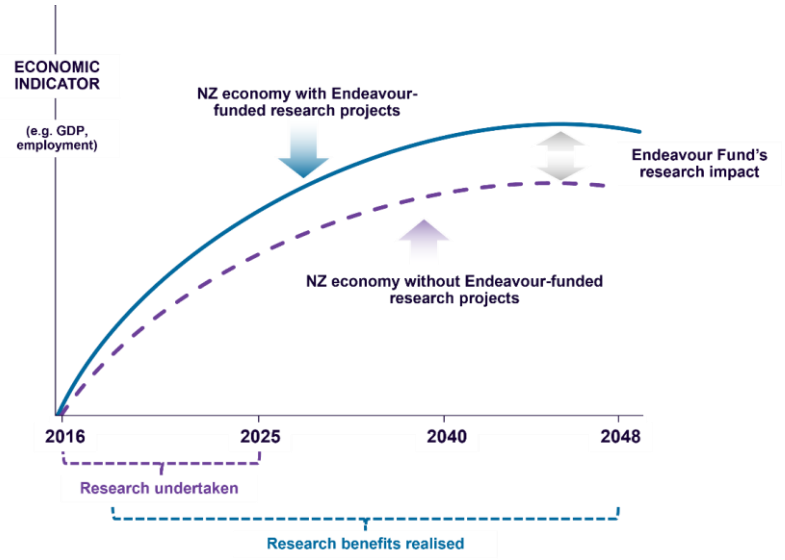
Appendices

A Detailed modelling approach

The economy-wide impacts of the Fund to the NZ economy was estimated using a Computable General Equilibrium (CGE) model of the global economy, the *Tasman Global* model.

To evaluate the Fund's economic impact on the NZ economy, *Tasman Global* was first used to project a business-as-usual (BAU) scenario where the Fund will be assumed to not have been created. This provided the counterfactual against which to judge the impact that the Fund has had on the economy. Then an alternative simulation was conducted based on assumptions regarding the direct benefits of Endeavour-funded research projects. This approach is illustrated in Figure A.1.

Figure A.1 Economic impact and the counterfactual



Source: ACIL Allen

A.1 Why use a CGE model to evaluate economic impacts?

An ex-post evaluation of research investments requires an understanding of what would have occurred in the absence of the program and the outputs generated by its funded research. Because this 'without R&D' scenario (the counterfactual) cannot be directly observed, it must be inferred through economic modelling.

Establishing this baseline is essential for assessing the extent to which a research fund such as the Endeavour Fund contributes to economic outcomes. CGE models are well suited to this task because they can simulate how the economy would evolve in the absence of a particular policy intervention (in this case, without the Fund and the research investments it supports).

Compared with simpler analytical approaches, such as partial or comparative cost benefit analysis, CGE models provide a more comprehensive framework for assessing economy-wide effects. They capture interactions across industries, households, governments and international markets, enabling the estimation of impacts on key macroeconomic indicators including GDP, exports, imports, consumption and investment. CGE models can also estimate changes in consumer welfare and living standards, allowing the impacts of programs such as the Endeavour Fund to be evaluated in terms of broader public benefits.

The use of CGE modelling also imposes a structured analytical discipline. Model assumptions, structures and results can be clearly articulated and interpreted within a well-established theoretical framework. This transparency enables results to be compared and assessed across different studies and policy contexts.

Importantly, the CGE framework captures both direct and indirect economic effects. As a representation of the interconnected New Zealand economy, the model reflects how changes in activity in one sector influence others through supply chains and market linkages. Consequently, the modelling captures flow-on effects from Endeavour-funded research outcomes, including upstream and downstream impacts across industries and regions.

CGE models are widely used by governments, industry and academic researchers to evaluate the impacts of policy actions, programs and major projects. As a result, the methodology and its outputs are well understood and broadly accepted by a wide range of stakeholders.

The following sections provide more details about the assumptions regarding the direct benefits of Endeavour-funded research projects, the simulation design and the inputs used for the economic modelling. Additional details about *Tasman Global* are provided in Appendix C.

A.2 Scenarios modelled

The modelling assessed the economic impact of projects awarded Endeavour grants between 2016 and 2025. To estimate this impact, 2 scenarios were simulated using the *Tasman Global* model:

— *Base Case scenario* — this business-as-usual (BAU) scenario assumes that the Endeavour Fund does not exist. It serves as the benchmark against which the results of the Endeavour scenario are compared.

— *Endeavour scenario* — this scenario assumes that the Fund was established and that grants were awarded over the period 2016 to 2025. It incorporates both funding provided by the Fund/MBIE and co-contributions from other parties.

For the historical period (2016–2025), the model aligns with the actual path of the New Zealand economy, reflecting observed changes in GDP, population, employment, trade, and other key indicators. The Base Case, by contrast, estimates how the New Zealand economy may have evolved had the Fund not been established.

The economic benefits attributable to the Fund over the analysis period are measured as the differences in outcomes between the Endeavour scenario and the Base Case scenario.

The inputs used to model the Endeavour scenario are described in further detail below.

A.3 Model inputs

Two sets of shocks were applied to *Tasman Global* in the Endeavour simulation: one reflecting the direct benefits of Endeavour-funded research activity, and the other capturing its costs.

The direct benefits of Endeavour-funded research were estimated using Endeavour project data, rates of return on public research investment drawn from national and international literature, and a range of supporting assumptions and parameters. In particular, the following were specified to quantify the direct benefits:

— the level and sources of investment in R&D activities

— the opportunity cost of that investment

— the assumed rate of return on research investment

— the industry sectors expected to benefit from research outputs

— the time lags over which returns accrue
— the useful life of research outputs
— the geographic distribution of research benefits.

Each of these elements is discussed in the sections that follow. The estimated direct benefits were incorporated into *Tasman Global* as input-neutral output productivity shocks applied to the industries identified as likely beneficiaries of Endeavour-funded research.

With respect to the costs of the Fund, it was assumed that, in the absence of Government funding for the program, the equivalent grant funding would have been reallocated to other areas of Government expenditure, potentially generating positive impacts elsewhere in the economy. An alternative counterfactual would assume that taxes were reduced by an amount equivalent to Endeavour funding. However, given the relatively small scale of Endeavour funding within the overall New Zealand Government budget, it is more plausible that the funds would have been redistributed within consolidated government revenue rather than returned through tax reductions.

A.3.1 Level and source of research investment

For studies of economic benefit to be credible, they must be grounded in a clearly articulated case for the additionality of the research's economic contribution. In assessing the net benefits of Endeavour-funded research? or project?, it is necessary to demonstrate that identifiable streams of economic benefits can be linked to Endeavour funding. However, this condition alone is not sufficient. It must also be shown that these benefits (or a substantial proportion of them) are additional (that is, they would not have occurred, or would not have occurred to the same extent, in the absence of Endeavour funding).

Assessing additionality requires consideration of 2 key questions:

— Would research projects have proceeded without Endeavour funding?
— To what extent would resources contributed by other parties to Endeavour-funded projects have been invested elsewhere within the New Zealand's science and innovation system?

Judgements on these questions are inherently subjective. Accordingly, estimated additionality rates should be interpreted as informed approximations rather than definitive measures.

The total funding awarded by MBIE between 2016 and 2025, together with co-contributions made or reported in grant applications (in current/nominal dollars), is presented in Table A.1. Over this 10-year period, MBIE awarded $2.31 billion in research funding. This was complemented by $1.0 billion in co-contributions from other sources.[92]

Table A.1 Funds awarded to research activities funded by the Endeavour Fund by funding source ($million, current dollars)

Awarded year	MBIE	Other sources	Total
2016	212	149	361
2017	253	99	352
2018	252	312	564
2019	240	114	353
2020	187	176	363
2021	244	65	309
2022	236	29	266

[92] Notably, these figures reflect actual co-contributions received between 2016 and 2023-24 and planned co-contributions (reported in grant applications) after 2023-24.

Awarded year	MBIE	Other sources	Total
2023	245	31	276
2024	236	24	260
2025	209	5	213
Total	2,314	1,004	3,318

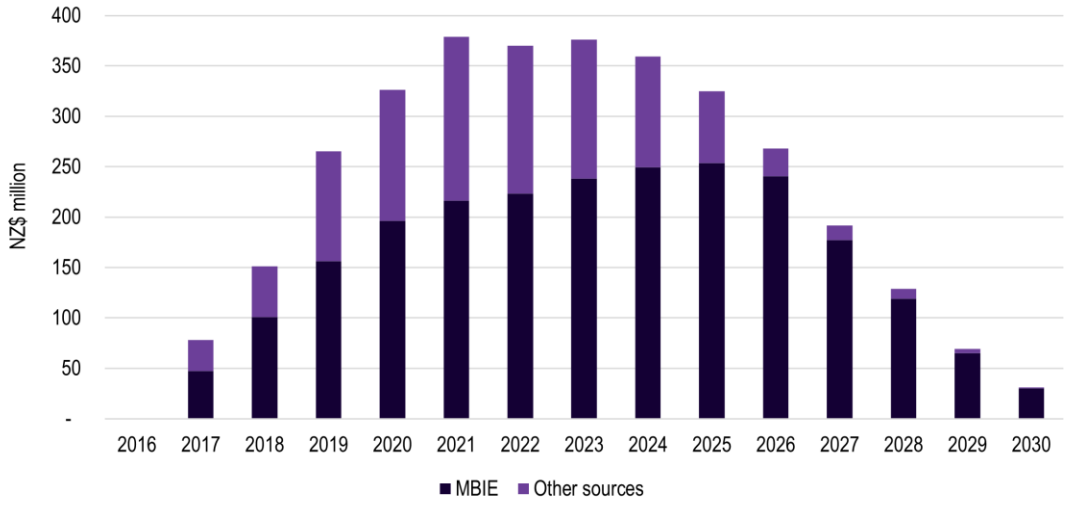
Note: All figures exclude GST.

Source: ACIL Allen based on MBIE data.

The actual amounts expended over the life of grants may differ from announced figures due to indexation and other factors (such as changes in partner financial commitments). For modelling purposes, annual research expenditure under each grant was assumed to equal the total MBIE funding awarded plus total reported co-contributions, divided evenly across the project duration specified in the MBIE dataset. As the start month of all awarded projects was October, it was assumed that funding effectively commenced in the following calendar year (e.g. a project marked as starting on 1 October 2016 would have 2017 as the first year of expenditure on research activities).

The resulting annual expenditure profile for Endeavour-funded research is shown in Figure A.2. While the modelling includes grants awarded between 2016 and 2025, expenditure extends to 2030, reflecting the duration of grants awarded in later years (for example, grants awarded in 2025 with a 5-year duration). The analysis also draws on grant reporting data available up to and including 2024, which represents the most recent year for which complete expenditure data were available at the time of analysis. In addition, as discussed above, it is assumed that the first expenditures on research happened in calendar year 2017. These timeframes are explained in more detail in Figure A.3.

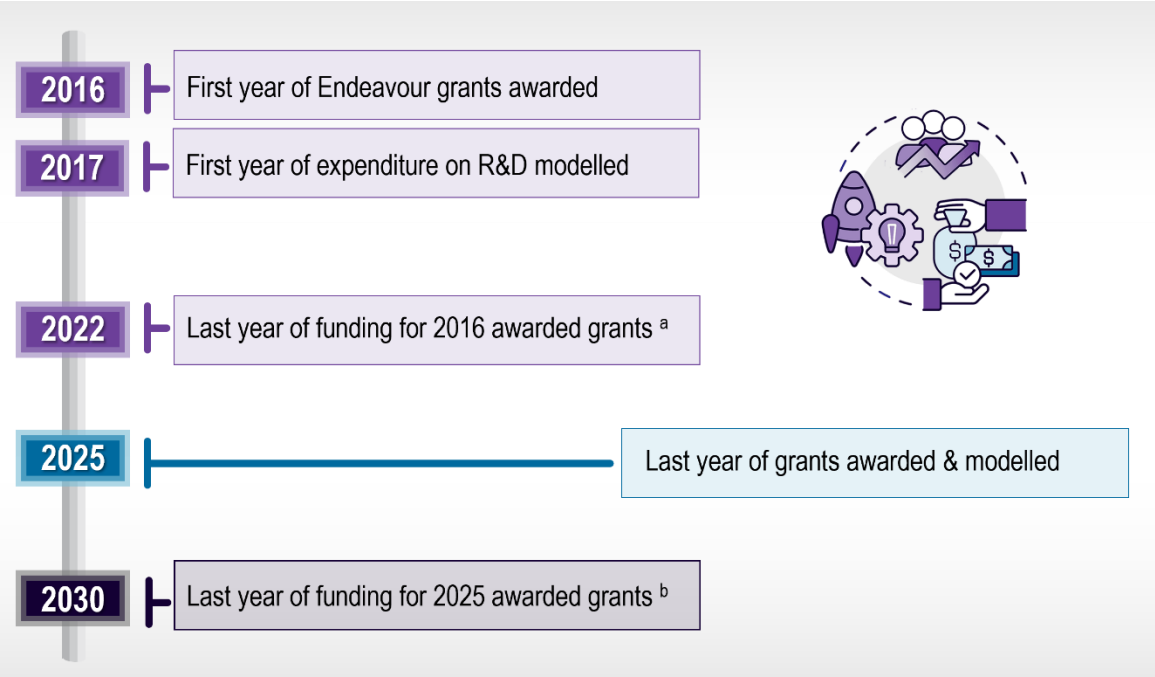
Figure A.2 Annual expenditure profile for Endeavour-funded research ($million, current dollars)



Note: All figures exclude GST.

Source: ACIL Allen based on MBIE data.

Figure A.3 Endeavour funding/payment timeframes



[a] The maximum duration of grants awarded in 2016 is 6 years.

[b] The maximum duration of grants awarded in 2025 is 5 years.

Source: ACIL Allen

For modelling purposes, nominal year-on-year expenditure under the Fund was converted into 2025 dollars. On this basis, total expenditure over the period 2017–2030 increases from $3.32 billion in nominal terms to $4.0 billion in 2025 dollars (see Table A.2).

Table A.2 Expenditure in Endeavour grants over the period 2017-30, $ million

	In current dollars (nominal terms)		In 2025 dollars	
	Total (2017-2030)	NPV (4% discount)	Total (2017-2030)	NPV (4% discount)
MBIE funding	2,314	1,820	2,735	2,173
Co-contributions	1,004	837	1,262	1,057
Total	3,318	2,657	3,997	3,230

Note: All figures exclude GST.

Source: ACIL Allen

All funding reported in Table A.1 and Table A.2 has been treated as additional for modelling purposes:

— New Zealand Government investment (Endeavour Fund grants) is assumed to be fully additional. In the absence of Endeavour funding, it is highly unlikely that the supported research would have proceeded. In the survey of researchers conducted for this study, 92% of respondents (for whom the question was applicable) indicated that it was unlikely or very unlikely that they would have been able to deliver any impacts without support from the Endeavour Fund.

— Co-contributions from other New Zealand organisations (including universities, Crown Research Institutes and organisations willing to fund research focussed on areas of specific interest) represent comparatively less mobile capital and may have remained within New Zealand even without Endeavour funding, which could suggest a lower additionality rate. However, New Zealand universities and Crown

Research Institutes are generally unlikely to redirect research investment offshore, and other domestic investors typically prefer to fund research where outcomes can be closely monitored.

— International co-contributions represent highly mobile capital that is attracted to New Zealand due to specific scientific infrastructure and expertise. Accordingly, the additionality rate for leveraged international investment is considered to be high.

A.3.2 Research investments that generate an economic return

Endeavour-funded projects deliver a wide range of important social, cultural and environmental benefits that are not reflected in market-based returns. In this analysis, these non-market impacts have not been monetised. Accordingly, only those research investments considered likely to generate a measurable market rate of return have been included in the economic modelling. The broader social, cultural and environmental impacts of Endeavour-funded projects were captured through separate evaluation, data collection and analysis processes, and are presented in section 4.

The proportion of Endeavour projects assumed to generate a quantifiable economic return was derived from survey responses (shown in Table A.3). Based on discussions with MBIE, the following adjustments and decisions were applied:

— For fields of research not coloured in Table A.3, the upper-bound estimate is used in the modelling (shown in bold).

— For fields of research highlighted in purple in Table A.3, the lower-bound estimate is used in the modelling.

— For fields of research highlighted in blue (History, Heritage and Archaeology; and Language, Communication and Culture), a conservative lower bound of 65% has been applied for consistency with the Human Society field, noting that the impact is likely to be immaterial given the relatively low level of investment in these categories.

The final proportions of Endeavour-funded projects assumed to generate a quantifiable economic return in the modelling are presented in Table A.4.

Table A.3 Proportion of survey responses indicating actual/anticipated impact by field of research

	Smart ideas		Research Programmes	
Field of research	Lower bound	Upper bound	Lower bound	Upper bound
Agricultural, Veterinary and Food Sciences	63%	100%	73%	91%
Biological Sciences	58%	90%	72%	89%
Biomedical And Clinical Sciences	73%	87%	100%	100%
Built Environment and Design	100%	100%	86%	100%
Chemical Sciences	63%	88%	92%	92%
Commerce, Management, Tourism and Services	-	-	100%	100%
Creative Arts and Writing	100%	100%	100%	100%
Earth Sciences	60%	100%	69%	88%
Economics	100%	100%	78%	100%
Education	-	-	67%	67%
Engineering	69%	100%	96%	100%
Environmental Sciences	70%	100%	78%	93%

	Smart ideas		Research Programmes	
Health Sciences	67%	100%	75%	88%
History, Heritage and Archaeology	100%	100%	100%	100%
Human Society	50%	50%	67%	89%
Indigenous Studies	100%	100%	82%	91%
Information And Computing Sciences	69%	100%	86%	100%
Language, Communication and Culture	100%	100%	50%	50%
Law And Legal Studies	-	-	100%	100%
Mathematical Sciences	25%	100%	67%	100%
Philosophy And Religious Studies	-	-	-	-
Physical Sciences	50%	100%	89%	100%
Psychology	100%	100%	50%	50%

Note: Based on survey responses to the question 'What (economic) impacts have/will the project(s) likely deliver?'. Percentages under 'Lower bound' include responses reporting that project 'Has produced impacts', and are 'Likely to result in impacts', upper bound percentages include responses reporting that project 'Has produced impacts', are 'Likely to result in impacts' and 'May result in impacts'.

Source: ACIL Allen.

Table A.4 Proportion of Endeavour-funded projects that are assumed to generate a quantifiable economic return in the modelling

Field of research	Smart ideas	Research programmes
Agricultural, Veterinary and Food Sciences	100%	91%
Biological Sciences	90%	89%
Biomedical And Clinical Sciences	87%	100%
Built Environment and Design	100%	100%
Chemical Sciences	88%	92%
Commerce, Management, Tourism and Services	0%	100%
Creative Arts and Writing	100%	100%
Earth Sciences	100%	88%
Economics	100%	78%
Education	0%	67%
Engineering	100%	100%
Environmental Sciences	100%	93%
Health Sciences	100%	88%
History, Heritage and Archaeology	65%	65%
Human Society	50%	67%
Indigenous Studies	100%	82%
Information And Computing Sciences	100%	100%
Language, Communication and Culture	65%	65%
Law And Legal Studies	0%	100%
Mathematical Sciences	25%	67%
Philosophy And Religious Studies	0%	0%
Physical Sciences	100%	100%

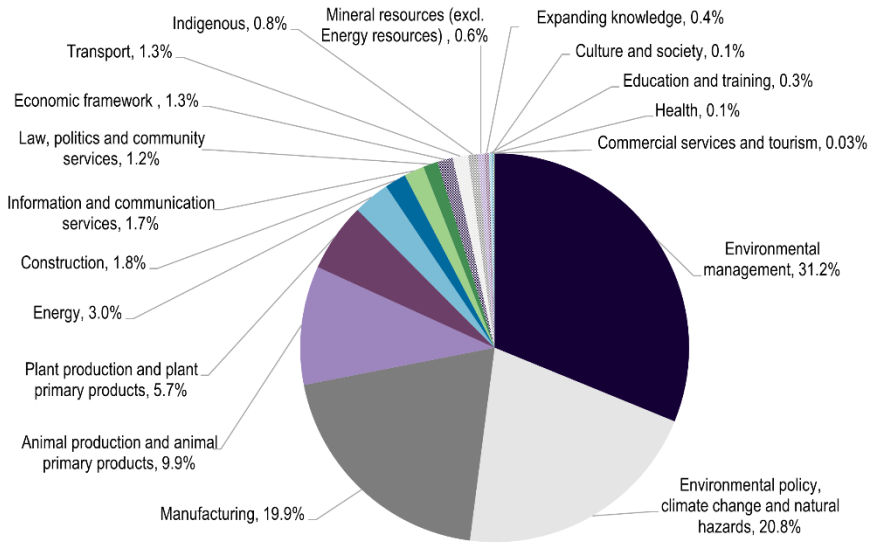
Field of research	Smart ideas	Research programmes
Psychology	100%	50%

Source: ACIL Allen

Based on the figures presented in Table A.4 and detailed project-level data provided by MBIE, approximately 91% of Endeavour funds invested between 2016 and 2025, together with the associated co-contributions (equivalent to $3.02 billion in nominal terms, or $3.64 billion in 2025 dollars), was assumed to generate an economic return and was therefore included in the modelling.

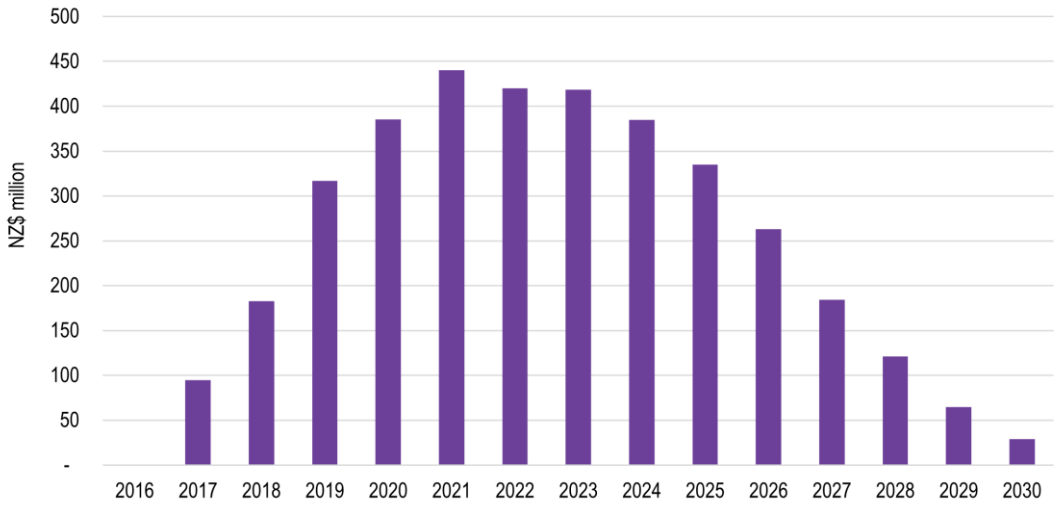
The distribution of modelled funding by FoR is presented in Figure A.4, and by year in Figure A.5.

Figure A.4 Distribution of funds included in modelling by FoR



Source: ACIL Allen based on MBIE data.

Figure A.5 Distribution of funds included in modelling by year, 2025 dollars



Source: ACIL Allen based on MBIE data.

A.3.3 Opportunity cost of investment

For the modelling, it has been assumed that, in the absence of the Endeavour Fund, the funds allocated to the Fund would have been allocated to general government expenditure (potentially having positive impacts elsewhere). An alternative counterfactual assumption could be that the amount of Endeavour funding could have lowered taxes.[93] However, given the scale of Endeavour funding in the overall New Zealand Government budget, it is more likely that the funds would have just been differently allocated out of consolidated government revenue.

A.3.4 Rate of return on investment

Research activities funded by the Endeavour Fund can generate positive productivity and knowledge spillovers as knowledge generated through these activities improves the productivity or processes of organisations. There are many ways in which research enabled by the Endeavour Fund can induce such positive spillover effects. For example, spillovers from universities to businesses would be enabled through direct R&D collaborations between the universities and firms, the publication and dissemination of research findings, or through upskilling of the talent pool available in the labour market.

One way to quantify the direct benefits of Endeavour-funded research would be to identify the outputs, outcomes and impacts directly generated by each of the research projects undertaken with Endeavour grants. However, given the scale of the program and the large number of projects funded during the period of analysis (a total of 623 projects), this approach is not feasible. Another way of quantifying these benefits would be to use estimates of the average rate of return to publicly funded research found in the literature and data on the Endeavour -funded research investments to estimate the potential direct benefits of research enabled by the Endeavour Fund. This is the approach used in this report.

A crucial variable to estimate the direct benefits of Endeavour-funded research using this approach is the assumed rate of return associated with the additional investment in Endeavour-funded research activities. A variety of metrics have been used in the R&D literature to describe/report the returns on research investment. These include:

— *Return on Investment (ROI)* — a simple indicator that shows the total percentage increase or decrease of an investment (the overall return of a research project from beginning to end). It is calculated by taking the change in value of the activity benefitting from the research from start to finish and dividing this amount by the initial research investment.

— *Internal rate of return (IRR)* — the IRR is a metric typically used in financial analysis to estimate the profitability of potential investments. The IRR is the discount rate that sets the net present value (NPV) of the change in value of the activity benefitting from the research over the assumed useful life of the research equal to zero in a discounted cash flow analysis. This approach normalises cashflows and produces a single annual rate of return for an investment.

— *Benefit cost ratio (BCR)* — a BCR is given by the ratio of the present value of a project's benefits from the research to the present value of its costs and can be interpreted as every one dollar of research costs delivers 'X' dollars of benefits.

For the purposes of estimating the direct impacts of Endeavour-funded research, we have used estimates of the IRR on research investments in the literature. Hence, references to rate of return to research investments refer to IRR estimates.

[93] An alternative counterfactual assumption that taxes are lowered by the amount of Endeavour funding in the absence of the program would have resulted in a reduction of the deadweight losses associated with taxation and a reduction in the estimated impacts of the program. The extent of this reduction would depend on the taxes that are assumed to have been reduced.

Some studies in the R&D literature publish only a BCR. To expand the available dataset of estimates from the literature, we have estimated an approximate IRR from these studies by using a method previously used by the Productivity Commission which suggests that a rough translation of the BCR to the IRR is *i* times the BCR, where *i* is the discount rate (Alston et al. 2000, cited in Productivity Commission 2007[94], p. 146).

Estimates of rates of return in the R&D literature can reflect different types of impacts. For instance, studies in the literature can:

- estimate the return on an R&D project that resulted in the workforce used in farms being more efficient (e.g. by increasing the skills of workers). The estimates of rates of return on this research project would reflect labour productivity improvements.
- estimate the return on an R&D project that reduces downtime or maintenance costs of manufacturing equipment. The estimates of rates of return on this research project would reflect improvements in capital productivity.
- assess a range of R&D projects which could result in a mix of labour productivity and capital productivity improvements, or in the creation of new technologies of products in specific industries (e.g. agriculture).
- assess an input productivity improvement associated with specific non-factor inputs (such as an energy efficiency improvement).
- assess an output productivity improvement associated with improving the total value of output for the same costs (such as through reducing wastage).

Given that it is not always clear what type of impacts the estimates of rates of return in the R&D literature are measuring (i.e. whether they are measuring labour, capital, multifactor, input or output productivity improvements), and that we do not have specific details about the nature/type of impacts produced by Endeavour-funded research projects, for modelling purposes the rates of return in the literature have been translated into improvements in output productivity in the industries that are assumed to benefit from Endeavour-funded research (i.e. the productivity gains are assumed to be input neutral). All else equal, assuming the research is improving output productivity will produce more conservative economic impacts compared to assuming all of the research generating economic returns result in factor productivity improvements.

The output productivity improvements from Endeavour-funded research were estimated by applying average rates of return to research investments based on their Socio Economic Objective (SEO). The rates of return by SEO used in the economic modelling are provided in Table A.6. These were based on the following assumptions.

- The rates of return applied to research investments in scientific fields were sourced from national and international literature on rates of return on R&D investments.
  - A review of the economic literature on rates of return to R&D shows consistent findings of a significant and positive rate of return on publicly funded R&D investments (despite methodological differences in the way these estimates were produced). Details about the literature review on rates of return on publicly funded R&D are provided in Appendix B.
  - When a directly relevant rate of return for a research project was available, the more specific estimates in Table A.5 were used. For instance, if a project's SOE is Plant Production and Plant Primary Products, then the rate of return to agricultural research presented in Table A.5 was used. When it was not possible to identify a particular type of R&D due to information restrictions, an overall rate of return on R&D in scientific fields of 35% was used.

[94] Productivity Commission (2007). *Public Support for Science and Innovation*. SSRN Electronic Journal. https://doi.org/10.2139/ssrn.1018883.

— No estimates of rates of return on research in social sciences, arts and humanities were found in the literature, and as such, rates of return were assumed instead.

Table A.5 Literature estimates used to calculate the direct benefits of research investments in scientific fields

Type of R&D	Literature estimates	IRR used in this study
Overall public R&D in scientific fields (including basic & applied research)	Literature estimates vary considerably, but many studies place the rate of return on overall publicly funded research in the order of 20% to 50%.	35%
Agricultural R&D	Literature estimates vary from 15% to 67%, but many are around 40%.	40%
Mining R&D	Literature estimates vary considerably, from 1% to 720%.	70%
Manufacturing/industrial research	Literature estimates vary from 12% to 28%.	Given the limited availability of estimates for social returns in this field, the rate of return for overall publicly funded research was used as a proxy for this category of research.
Health/medical R&D	Studies in the literature report returns between 7% and 80%.	45%

Note: Additional detail about these estimates is provided in Appendix B.

Source: ACIL Allen

Table A.6 Assumed type of R&D for each modelled SOE

SEO	Assumed type of R&D	Rate of return
Manufacturing	Public R&D (literature estimates)	35%
Animal production and animal primary products	Agricultural R&D (literature estimates)	40%
Environmental management	Public R&D (literature estimates)	35%
Plant production and plant primary products	Agricultural R&D (literature estimates)	40%
Expanding knowledge	Public R&D (literature estimates)	35%
Construction	Public R&D (literature estimates)	35%
Environmental policy, climate change and natural hazards	Public R&D (literature estimates)	35%
Health	Health/medical R&D	45%
Economic framework	Public R&D (assumption)	10%
Education and training	Public R&D (assumption)	15%
Transport	Public R&D (literature estimates)	35%
Culture and society	Public R&D (assumption)	5%
Information and communication services	Public R&D (literature estimates)	35%
Indigenous	Public R&D (assumption)	5%
Energy	Public R&D (literature estimates)	35%
Mineral resources (excl. Energy resources)	Mining R&D (literature estimates)	70%
Commercial services and tourism	Public R&D (literature estimates)	35%

SEO	Assumed type of R&D	Rate of return
Law, politics and community services	Public R&D (assumption)	10%

Note: The category named 'Public R&D (literature estimates)' is based on estimated rates of return to overall public R&D in scientific fields (including basic & applied). No estimates of rates of return in non-scientific fields (research in social sciences, arts and humanities) were found in the literature and hence assumptions were made in discussions with MBIE about a potential rate of return to research in these areas (noted in the table above as 'Public R&D (assumption)').

Source: ACIL Allen and MBIE

A.3.5 Time lags and useful life of research

For the calculation of benefits, it was assumed that the returns on investment (i.e. the benefits) from Endeavour-funded research will be achieved on average:

— 4 years after the investment is made for Research Programmes projects

— 6 years after the investment is made for Smart Ideas projects.

These time lags assumptions were based on survey results (see Table A.7) and consultation with sector leaders.

The economic modelling also assumes that the useful economic life of outcomes generated or enabled through Endeavour-funded research activities is, on average, 15 years (i.e. the economic modelling does not include any economic impacts from Endeavour -funded research beyond 15 years after the investment is made). Previous evaluations of research institutes conducted by ACIL Allen used the 20-year standard for patent life generally recognised in patent legislation as the indicator of the useful economic life of research. However, not all the Endeavour-funded research projects produce commercial outputs, so a 15-year period used is considered a reasonable average.

Table A.7 Time lags for the realisation of research benefits

	Percentage of respondents that think economic impacts would be realised in the specified timeframe		Assumed midpoint for calculation of weighted average (years)
	Smart Ideas	Research Programmes	
Short (within 1 year of project conclusion)	3%	13%	1
Medium (within 2-5 years of project conclusion)	29%	38%	3.5
Long (beyond 5 years of project conclusion)	62%	38%	7.5
Not applicable	5%	11%	
Weighted average	5.7	4.3	

Source: ACIL Allen based on survey results.

A.3.6 Industry sectors receiving the benefits

As part of our modelling approach, we identified the sectors of the economy that are most likely to benefit from the Endeavour-funded research, based on the research projects over 2016-2025. Benefits from Endeavour-funded research were allocated between divisional structures of the Australian and New Zealand Standard Industrial Classification (ANZSIC). This allocation was made based on analysis of SEO codes and FOR codes of each of the research projects. The table below shows *broadly* how the industries that benefits were assigned.

Table A.8 Broad mapping of industries that benefit from ARC-funded research based on SEO

SEO	ANZSIC Division
Defence	Public Administration and Safety
Plant Production and Plant Primary Products	Agriculture, Forestry and Fishing
Animal Production and Animal Primary Products	Agriculture, Forestry and Fishing
Mineral Resources (excl. Energy Resources)	Mining
Energy	Benefits divided equally between the following divisions/subdivisions: – Oil and Gas Extraction – Electricity Supply – Gas Supply
Manufacturing	Manufacturing
Construction	Construction
Transport	Transport, Postal and Warehousing
Information and Communication Services	Information Media and Telecommunications
Commercial Services and Tourism	Benefits divided equally between the following divisions/subdivisions: – Water Supply, Sewerage and Drainage Services – Waste Collection, Treatment and Disposal Services – Accommodation and Food Services – Financial and Insurance Services – Rental, Hiring and Real Estate Services – Professional, Scientific and Technical Services – Administrative and Support Services
Economic Framework	See approach in table below

If FoR is:	Then industry that benefits:
Mathematical Sciences	Benefits divided equally between across all industries
Physical Sciences	Benefits divided equally between across all industries
Chemical Sciences	Manufacturing
Earth Sciences	Mining
Environmental Sciences	Agriculture, Forestry and Fishing
Biological Sciences	Agriculture, Forestry and Fishing
Agricultural, Veterinary and Food Sciences	Agriculture, Forestry and Fishing
Information and Computing Sciences	Information Media and Telecommunications
Engineering	Manufacturing
Biomedical and Clinical Sciences	Health Care and Social Assistance
Health Sciences	Health Care and Social Assistance
Built Environment and Design	Construction
Education	Education and Training
Economics	Financial and Insurance Services

SEO	ANZSIC Division
	Commerce, Management, Tourism and Services: Benefits divided equally between the following divisions/subdivisions: – Water Supply, Sewerage and Drainage Services – Waste Collection, Treatment and Disposal Services – Accommodation and Food Services – Financial and Insurance Services – Rental, Hiring and Real Estate Services – Professional, Scientific and Technical Services – Administrative and Support Services
	Human Society: Arts and Recreation Services
	Psychology: Professional, Scientific and Technical Services
	Law and Legal Studies: Public Administration and Safety
	Creative Arts and Writing: Arts and Recreation Services
	Language, Communication and Culture: Arts and Recreation Services
	History, Heritage and Archaeology: Arts and Recreation Services
	Philosophy and Religious Studies: Arts and Recreation Services
	Indigenous Studies: Arts and Recreation Services
Health	Health Care and Social Assistance
Education and Training	Education and Training
Law, Politics and Community Services	Administrative and Support Services
Culture and Society	Arts and Recreation Services
Environment management	Agriculture
Environmental policy, climate change and natural hazards	Agriculture
Expanding Knowledge	See approach in table below

If FoR is:	Then industry that benefits:
Mathematical Sciences	Benefits divided equally between across all industries
Physical Sciences	Benefits divided equally between across all industries
Chemical Sciences	Manufacturing
Earth Sciences	Mining
Environmental Sciences	Agriculture, Forestry and Fishing
Biological Sciences	Agriculture, Forestry and Fishing
Agricultural, Veterinary and Food Sciences	Agriculture, Forestry and Fishing
Information and Computing Sciences	Information Media and Telecommunications
Engineering	Manufacturing
Biomedical and Clinical Sciences	Health Care and Social Assistance
Health Sciences	Health Care and Social Assistance
Built Environment and Design	Construction
Education	Education and Training
Economics	Financial and Insurance Services
Commerce, Management, Tourism and Services	Benefits divided equally between the following divisions/subdivisions: – Water Supply, Sewerage and Drainage Services – Waste Collection, Treatment and Disposal Services – Accommodation and Food Services – Financial and Insurance Services – Rental, Hiring and Real Estate Services

SEO	ANZSIC Division	
		– Professional, Scientific and Technical Services – Administrative and Support Services
	Human Society	Arts and Recreation Services
	Psychology	Professional, Scientific and Technical Services
	Law and Legal Studies	Public Administration and Safety
	Creative Arts and Writing	Arts and Recreation Services
	Language, Communication and Culture	Arts and Recreation Services
	History, Heritage and Archaeology	Arts and Recreation Services
	Philosophy and Religious Studies	Arts and Recreation Services
	Indigenous Studies	Arts and Recreation Services
Indigenous	Arts and Recreation Services	

A.3.7 Geographic boundaries of returns from research

To model the impact of Endeavour-funded research activities, assumptions must be made about the geographic boundaries within which the returns from the research activity accrue. Given the national nature of the Endeavour, the modelling assumes that all research benefits stemming from Endeavour funding will flow to all New Zealanders.

A.3.8 Modelling inputs

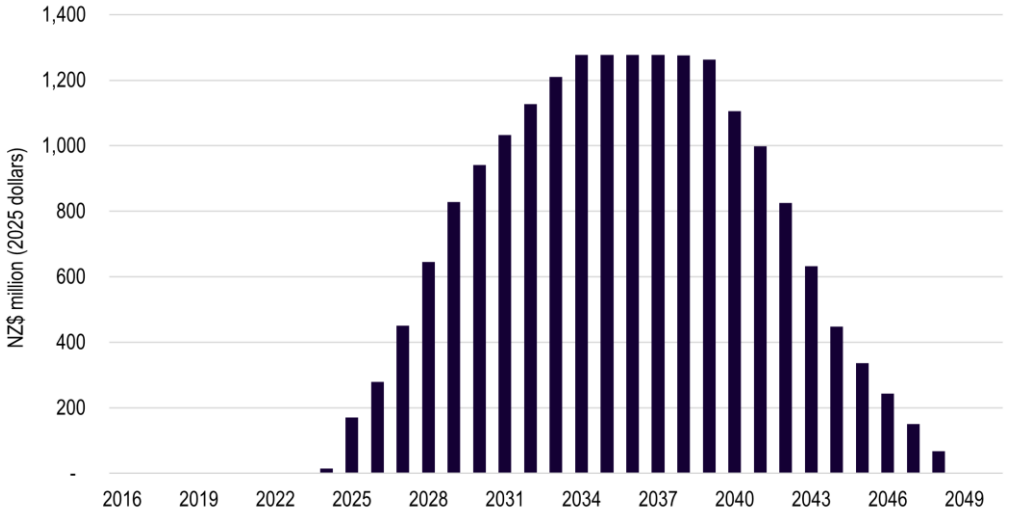
Using the data and assumptions outlined in the previous sections, a set of shocks were developed to apply to the *Tasman Global* model related to the benefits of the investment in Endeavour-funded research activities.

The investment associated with Endeavour-funded research activities is factored into the modelling in the years it occurs (as per Figure A.2). Depending on the industry that benefits, a few years after the installation of the investment (according to the lags outlined in section A.3.5), output productivity shocks (i.e. the estimated direct benefits of the research activities) are applied to the New Zealand industry sectors that benefit from Endeavour-funded research activities.

The *Tasman Global* model then simulates the effects of this investment and lagged productivity shocks for New Zealand as a whole.

The direct benefits of funds awarded through the Endeavour Fund over the period 2016-2025 estimated based on the inputs and assumptions described in the previous sections are outlined in Figure A.6. Taking into consideration the lags and the duration of benefits, it is estimated that as a result of the $4.0 billion research spend between 2016 and 2025 (in 2025 dollars), the direct benefit to the New Zealand economy is a cumulative total of $19.2 billion in real (2025) terms between 2016 and 2048.

Figure A.6 Total estimated direct benefits over the period 2016–2048 associated with Endeavour research investments made between 2016 and 2025, relative to the Base Case (2025 dollars)



Source: ACIL Allen

The total estimated direct benefits by ANZSIC industry are summarised in Table A.9. The agriculture, forestry and fisheries sector is expected to receive the highest benefits (70%), followed by the manufacturing sector (19.7%).

Table A.9 Total estimated direct productivity benefits by ANZSIC sector 2002-2046

ANZSIC industry	Estimated benefits ($m), 2025 dollars	Percent of total benefits
Public Administration and Safety	6,794,314	0.04%
Agriculture, Forestry and Fishing	13,462,153,946	70.27%
Mining	217,284,279	1.13%
Oil and Gas Extraction	200,519,192	1.05%
Electricity Supply	200,519,192	1.05%
Gas Supply	200,519,192	1.05%
Manufacturing	3,765,657,021	19.65%
Construction	346,135,776	1.81%
Transport, Postal and Warehousing	248,833,179	1.30%
Information Media and Telecommunications	308,214,278	1.61%
Water Supply, Sewerage and Drainage Services	7,762,469	0.04%
Waste Collection, Treatment and Disposal Services	7,762,469	0.04%
Accommodation and Food Services	7,762,469	0.04%
Financial and Insurance Services	7,762,469	0.04%
Rental, Hiring and Real Estate Services	7,762,469	0.04%
Professional, Scientific and Technical Services	7,762,469	0.04%
Administrative and Support Services	73,021,842	0.38%
Health Care and Social Assistance	25,377,756	0.13%

ANZSIC industry	Estimated benefits ($m), 2025 dollars	Percent of total benefits
Education and Training	27,037,792	0.14%
Arts and Recreation Services	30,233,925	0.16%
TOTAL BENEFITS	19,158,876,500	100%

Source: ACIL Allen

A.4 Labour market sensitivity

As discussed in section 3.1.3, the projected economic impacts associated with Endeavour-funded research depend partly on the assumed availability of labour in the economy. In the central modelling scenario, labour supply is allowed to adjust relative to the base case through changes in participation rates, hours worked, and unemployment, reflecting the standard labour market assumptions in Tasman Global.

This section tests the sensitivity of the modelling results to 2 alternative (and deliberately extreme) labour market assumptions:

— Fully constrained labour market — the national supply of labour is fixed, meaning that total labour availability does not change with or without the Endeavour Fund. Any additional labour demand must therefore be met entirely through the reallocation of workers from other sectors of the economy, rather than through an expansion in overall labour supply.

— Unconstrained labour market — it is assumed that sufficient labour is available to meet any additional labour demand generated by the Fund relative to the counterfactual. In this scenario, additional employment can occur without displacing labour from other industries.

These scenarios provide insight into how sensitive the results are to key modelling assumptions regarding the availability of labour and the extent to which additional activity generated by the Fund may crowd out employment in other parts of the economy. The results of this sensitivity analysis are presented in Figure A.7 and Table A.10.

The results indicate that the projected macroeconomic impacts are materially affected by assumptions about labour market flexibility:

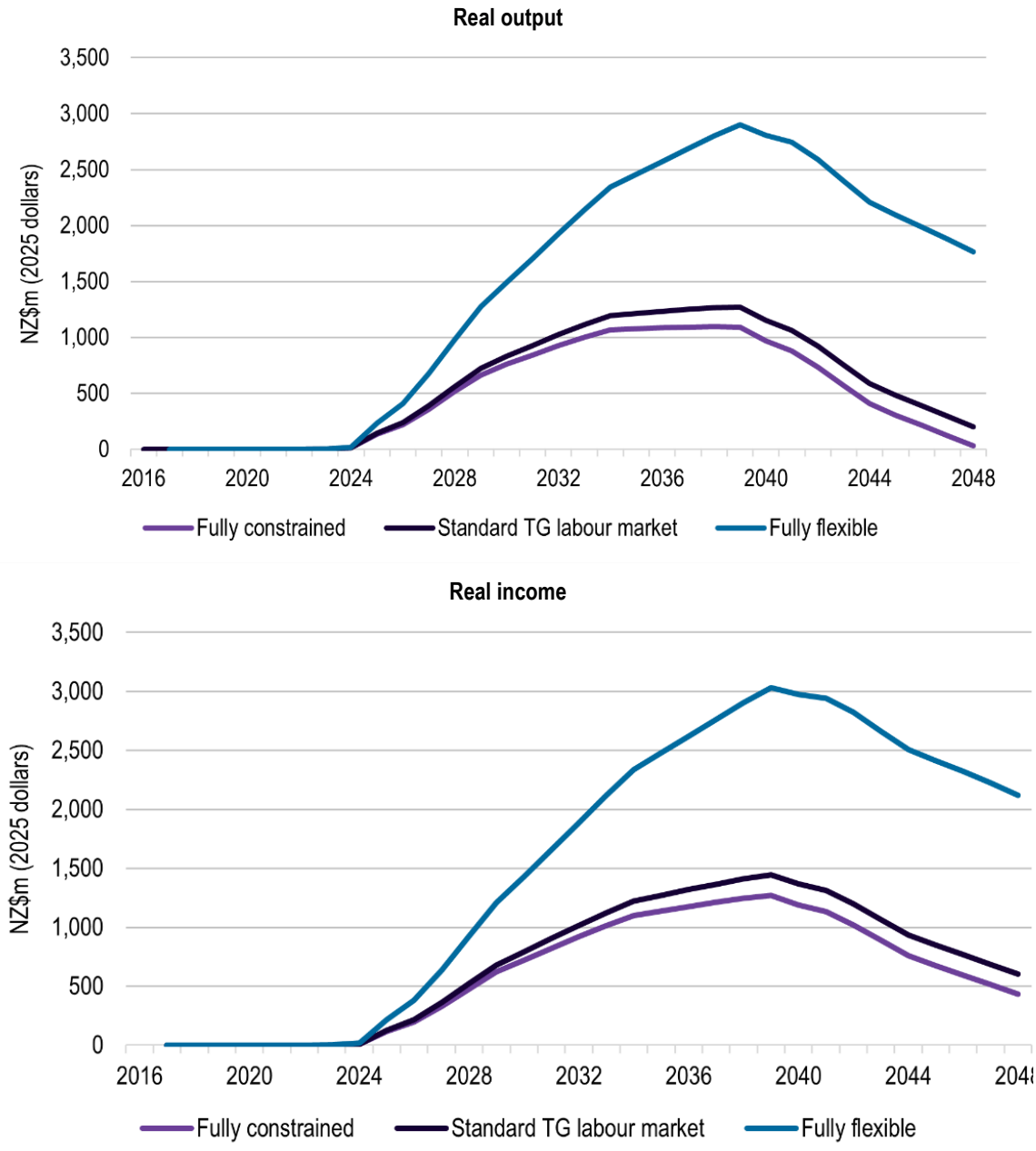
— In the fully constrained labour market scenario, it is assumed that no additional workers enter employment and that workers do not increase their hours in response to higher wages relative to the counterfactual. While this is not considered a realistic representation of labour market behaviour, it provides a conservative lower bound for the estimated economic impacts (all else equal).

— The opposite assumption is applied in the unconstrained labour market scenario, where it is assumed that sufficient labour is available to meet all additional labour demand generated by the Fund (at counterfactual wage rates) without displacing workers from other industries. This does not imply an unlimited supply of labour, but rather that labour availability does not constrain the expansion of activity associated with the Fund. With the exception of other factor constraints, this assumption is broadly consistent with the upper-bound employment effects typically derived from input–output multiplier analysis.[95]

Overall, the results highlight the importance of labour market responsiveness in determining the macroeconomic outcomes of the Fund. Where labour supply is able to expand in response to higher demand, the economy can accommodate the additional activity generated by the Fund more effectively. Conversely, where labour supply is fixed, the primary effect is a reallocation of labour between sectors, which reduces the net economic gains.

[95] More specifically, Type 2A employment multipliers which include the direct, production induced and consumption induced effects.

Figure A.7 Labour market sensitivity – projected change in New Zealand real GDP and real income, relative to the counterfactual



Source: ACIL Allen

Table A.10 Labour market sensitivity – projected change in New Zealand real GDP and real income under different labour market assumptions, relative to the counterfactual (real 2025 terms, NZ$m)

	Standard Tasman Global labour market		Fully constrained labour supply		Fully flexible labour supply	
	Total (2017-2048)	NPV4	Total (2017-2048)	NPV4	Total (2017-2048)	NPV4
Real GDP	19,248	9,164	16,164	7,850	47,082	21,018
Real income	22,576	10,304	19,582	9,029	49,598	21,809

Source: ACIL Allen

B Literature review of rate of return on research

This section examines the literature on the rate of return (ROR) to public R&D. This review has drawn on New Zealand literature as well as literature from Australia, the United States, United Kingdom, European Union and other Organisation for Economic Co-operation and Development (OECD) countries to ensure a holistic examination of R&D ROR.

B.1 Glossary of key terms

Consumer surplus	Consumer surplus is a measure of economic welfare, and it is defined as the difference between what a consumer would be willing to pay for a good or service and what they actually have to pay.
Econometric vector error correction model (VECM)	The error correction model (ECM) is a time series regression model based on the behavioural assumption that 2 or more time series exhibit an equilibrium relationship that determines both short-run and long-run behaviour. A vector error correction model (VECM) adds additional error correction features to the ECM approach through a multi-factor model known as vector autoregression. An autoregressive model uses observations from previous time steps as input to regression equations to predict the value at the next step.
Economic surplus approach	Economic surplus considers both consumer surplus and producer surplus. The producer surplus is the difference between the actual price of a good or service–the market price–and the lowest price a producer would be willing to accept for a good. The sum of consumer and producer surplus results in the total economic surplus.
Jones and Summers (2020) approach	The Jones and Summers approach is a macro-level approach that draws on modern innovation-based growth theory to show how average returns to innovation can be calculated by linking the total cost of innovation investments to economy-wide gains in GDP.
Macro-economic modelling approach	A macroeconomic model is an analytical tool designed to replicate the operation of the global or individual country's economy. It examines the dynamics of important economic indicators like output, inflation and unemployment. Benefits are calculated by examining increases in the economy's output.
Present value	The value of a future stream of income (or expenses) converted into current terms by an assumed annual discount rate. The underlying premise is that receiving, say, $100 in 10 years is not 'worth' the same (i.e. is less desirable) than receiving $100 today.
Production function approach	The production function depicts the relation between physical outputs of a production process and physical inputs, i.e. factors of production. The practical application of production functions is obtained by valuing the physical outputs and inputs by their prices. The economic value of physical outputs minus the economic value of physical inputs is the income generated by the production process.
Real discount rate	An interest rate that has been adjusted to remove the effects of inflation.

Total factor productivity approach	The total factor productivity approach describes the relationship between output in real terms and the inputs involved in its production. It is a commonly used device for explaining the economic output and development of national economies.

B.2 Literature review methodology

B.2.1 Overview of the approach

A 4-step process was used to perform the systematic literature search:

- **Identify parameters of the literature review:** ensuring the review is targeted appropriately and will answer key research questions posed.
- **Identify relevant search terms and databases:** including the identification of leading researchers, journals, authorities and other information sources, aligned with relevant research questions.
- **Define inclusion and exclusion criteria:** for example, the eligible time period of publications, type of publication (e.g. journal article and newspaper article), and the origin of the publication or its source.
- **Assess the quality and weight of evidence:** this step ensures that only reliable and robust evidence is reported.

This process is detailed below.

B.2.2 Search strategy

Parameters of the literature review

The systematic literature search drew on a range of resources to collate the most contemporary evidence on rates of return to R&D. The literature review categorised research by the industry/subject focus (see list below).

Search terms and databases

The search terms will include:

- public funding / private funding
- funding
- research
- rate of return / return on investment
- value / value for money
- research areas:
  - academic science research
  - basic research
  - chemical research
  - mining research
  - agricultural research
  - industrial research
  - manufacturing research
  - medical research

- social science research
- humanities research
- environmental research
- chemical research.

Appropriate variations were used to account for word variations and plurals.

The literature review required a mix of database and purposive/ targeted searches, as well as the 'Snowballing' technique. Snowballing involves identifying further resources from resources identified through the database and purposive/ targeted searches (for example, in reference lists).

The search was conducted across the ProQuest ABI/INFORM® Professional Advanced, Australian Education Index, British Library Inside Conferences, Current Contents® Search, NTIS National Technical Information Service, PAIS International, ProQuest Dissertations and Theses Professional, SciSearch®: a Cited Reference Science Database, Social SciSearch®, and Transport Research International Documentation electronic database using combinations of the search terms outlined above.

This work expanded on ACIL Allen's rates of return of R&D repository, which summarises published estimates of rates of return to publicly funded R&D.

Inclusion and exclusion criteria

The following parameters were included in the search process:

- New Zealand literature preferred, but literature from other OECD countries will also be examined
- literature published in English
- peer reviewed literature and grey literature.

Quality and weight of evidence

The evidence was assessed, taking into consideration the weight of evidence according to 3 factors:

- *Topic relevance*: the alignment of the focus of the research with Endeavour Fund funded research
- *Methodological quality*: the trustworthiness of the results judged by the quality of the study within the accepted norms for undertaking the particular type of research design used in the study
- *Methodological relevance*: the appropriateness of the use of that study design for informing the rate of return analysis.

B.3 The role of R&D in an economy

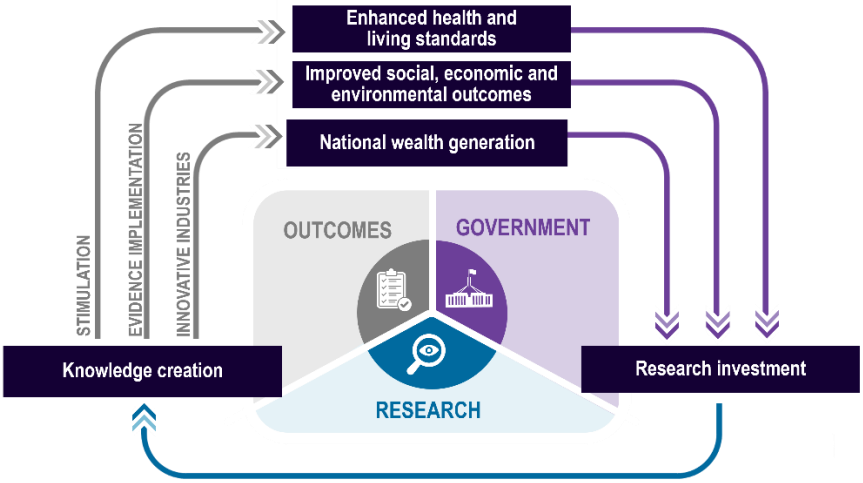
Research and innovation lead to the development of new and efficient processes, technologies and products, which improve living standards when deployed across the economy. Indeed, New Zealand's national wellbeing, as reflected in the health and lifestyle of the population and the security and sustainability of the environment in which New Zealanders live, is dependent on research and innovation.[96]

Publicly funded research can enhance health and living standards, improve economic, social and environmental outcomes, and create national wealth. It can also raise national productivity, increase national competitiveness, create new jobs and increase tax revenues. Publicly funded research contributes to a

[96] Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE) (2012). 2012 National Research Investment Plan.

valuable innovation cycle that ultimately permits further investment in research.[97] This cycle is illustrated in Figure B.1.

Figure B.1 The cycle of publicly funded research



Source: ACIL Allen based on NHMRC 2010.

The range of economic benefits generated from research is extensive. Martin and Salter (2001) have suggested the main benefits of publicly funded research that led to economic growth are:[98]

- increasing the stock of useful knowledge
- training skilled graduates
- creating new scientific instrumentation and methodologies
- forming networks and stimulating social interaction
- increasing the capacity for scientific and technological problem solving
- creating new firms.

In addition to economic benefits, R&D investments are crucial to address key societal challenges and improve well-being as they contribute to enhancing health outcomes, fighting against climate change and building more inclusive and resilient societies.[99]

At a business level, the benefits of innovation (which includes R&D activities) have been demonstrated by decades of economic research. Indeed, innovation has been demonstrated to drive productivity growth and the competitive advantage of businesses, with innovative businesses out-competing other businesses by achieving higher rates of business survival and growth in employment and profits.[100]

B.4 The economic impact of R&D

While it is widely acknowledged that research leads to a wide range of benefits, it is also well-documented that the impact of research is difficult to measure. More specifically, the creation, transfer and subsequent

[97] National Health and Medical Research Council (NHMRC) (2010). Strategic Plan 2010-2012, p.3.

[98] Salter, A. J., & Martin, B. R. (2001). The economic benefits of publicly funded basic research: a critical review. *Research Policy*, 30(3), 509–532. https://doi.org/10.1016/S00487333(00)000913.

Note that where these benefits cannot be quantified, they have been considered qualitatively in the main report, see sections 2 and 3.

[99] European Commission (2017). *The Economic Rationale for Public R&I Funding and its Impact*, Brussels. Accessed October 2022: http://bookshop.europa.eu/en/the-economic-rationale-for-public-r-i-funding-and-itsimpact-pbKI0117050/.

[100] Department of Industry, Innovation and Science (DIIS) (2016). *Australian Innovation System Report 2016*.

application of knowledge and the success and effect of this are difficult to measure. This is because the relationship between research, knowledge transfer, application and the economic, social and other outcomes these can produce is complex.

Numerous studies have addressed the ROR on public and private investments in research, and while there are variations in the methodologies used across studies, the strong consensus is that the ROR is high. Indeed, according to most studies, the overall value generated by public research is between 3 and 8 times the initial investment over the entire life cycle of the effects.[101] When calculated in terms of annual ROR, private ROR to R&D investments are estimated at around 10-30%[102] and social ROR on publicly funded research in the order of 20-50% a year (in fact, the former Australian Department of Industry, Science, Energy and Resources suggest that ROR are more than 40% for social return).[103]

The section below reviews and summarises a selection of studies available in the academic literature on the economic impacts of publicly funded R&D.

Empirical studies conducted in the 1980s and 1990s have often indicated a ROR typically of between 20% and 50% for public R&D.[104]

The Productivity Commission (2007) suggests that even when uncertainty about the parameters is considered, the social ROR of publicly supported R&D is mostly above 35% and below 100%.[105]

An analysis conducted by the Allen Consulting Group for the ARC in 2003 estimated an overall social ROR (SROR) of 25% for the decade 1990-00 using a top-down approach.[106] This was done by first determining the increase in GDP for the period, estimating the proportion of the increase in GDP that could be directly attributed to the increase in total factor productivity (previously known as multi-factor productivity) growth, then determining what proportion of the total factor productivity growth could be attributed to public R&D. The report then translates this dollar figure increase in GDP due to public R&D activities into the social ROR on public research funding, by dividing the dollar value of the increase in GDP due to Public R&D by the total Public R&D funding amount for the period (more details on this methodology is presented in the main report).

There are several ways to estimate ROR figures, each with various benefits and shortfalls. A description of the methods that appear in this literature review is provided in Box B.1.

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[101] Georghiou, L. (2015). *Value of Research*, Policy Paper by the Research, Innovation, and Science Policy Experts. European Commission.

[102] Department of Industry, Innovation and Science (DIIS) (2016). Op. cit.

[103] Ibid.

The private ROR is the ROR that an individual or company receives from an investment. It represents the financial benefits that the investor gets from the investment. The private ROR is typically calculated as the ratio of the profits or benefits gained from the investment to the costs of the investment. On the other hand, the social ROR represents the overall benefit to society that results from an investment. It takes into account not only the financial benefits but also the broader social benefits, such as improvements in health, education, and the environment. The social ROR is calculated as the ratio of the total benefits to society to the costs of the investment.

Dyakova, M, et al. (2020). *Health Evidence Network Synthesis Report 51*. World Health Organization.

[104] Martin, B. (2007). *Assessing the Impact of Basic Research on Society and the Economy*.

[105] Productivity Commission (2007). Public Support for Science and Innovation. *SSRN Electronic Journal*. https://doi.org/10.2139/ssrn.1018883.

[106] Allen Consulting Group (2003). *A Wealth of Knowledge: The return on investment from ARC-funded research*, report for the Australian Research Council.

Box B.1 Economic modelling approaches used to estimate the returns to research investments

This box describes the economic modelling approaches that have been used to estimate the returns to research investments in the literature included in this review.

— Case study approach: An extremely common approach for estimating returns on investment (especially to innovation) are case studies of specific projects and programs, as they are a relatively simple way to demonstrate the benefits and need for funding of the project or program. In general, these studies calculate the present value of the total benefits to the present value of the total costs involved, both privately and for the broader economy. The benefit of the approach is that it can provide a more holistic picture of the activities and benefits of the program (rather than the economics alone). A limitation of this approach is that it is difficult to apply if there are a large number of projects/programs.

— Macro-economic modelling approach: The macro-economic modelling approach assumes various (often complex) macroeconomic functional forms and their parametric values to calculate the returns to investment and provides the basis for studies that use computable general equilibrium (CGE) modelling. CGE models treat economic benefits (e.g. additional revenue based on an R&D innovation) as a positive "productivity shock" to derive estimated GDP impacts. A benefit of this approach is that it provides a way to analyse the impacts of policies and programs on an entire economy, including interactions between different sectors and households. A limitation of this method is that it is complex and often needs specialist skills and software to conduct.

— The Jones and Summers (2020) approach: This approach is a novel, yet simple, macro-level approach developed by Jones and Summers in 2020. It draws on modern innovation-based growth theory to show how average returns to innovation can be calculated by linking the total cost of innovation investments to economy-wide gains in GDP. The approach's key advantages are that it examines the aggregate path of GDP as a result of R&D expenditure and estimates average returns; and applies individual "adjustments" to recalculate the baseline results and emphasise particular features of innovation activity (e.g., delays in benefits realisation or the role of capital expenditure). A limitation is that it excludes non-monetary, societal and environmental benefits.

— Production Function approach: The production function approach models the relationship between the quantities of productive factors (such as labour and capital) used and the amount of product obtained. The production function can answer a variety of questions, for example, it can measure the marginal productivity of a particular factor of production (i.e., the change in output from one additional unit of that factor). It can also be used to determine the cheapest combination of productive factors that can be used to produce a given output. A benefit of this approach is that it provides a framework for understanding the relationship between inputs and outputs in the production process. Limitations of this approach depend on the type of production function used. For example, the Cobb-Douglas production function shows constant returns to scale, which are not an actuality.

- Total factor productivity approach: Total factor productivity (TFP) is a measure of the efficiency with which inputs are used in production. As both output and inputs are expressed in term of volume indices, the indicator measures TFP growth. To aggregate the different output (and input) volume indices, the production (and input) values are used as weights. This allows capturing the relative importance between outputs, or inputs. An increase in TFP reflects a gain in output quantity which does not originate from an increase of inputs. A benefit of this approach (particularly for innovation) is that it can help identify sources of productivity growth, such as technological progress. A limitation is that it does not account for externalities or other factors that may affect productivity, such as improvement of air or water quality.
- Economic surplus approach: The economic surplus approach is based on the concept of economic surplus, which is the difference between the maximum amount that consumers are willing to pay for a good or service and the minimum amount that producers are willing to accept as payment for supplying that good or service. A benefit of this approach is that it can be used to consider net welfare effects of policies or programs, by comparing the economic surplus before and after the policy or program is implemented. A limitation of this method is that it can be difficult to collect accurate data on what consumers are willing to pay for a good or service.
- Cost benefit analysis approach: Cost benefit analysis (CBA) is an economic modelling approach which involves comparing the total costs of implementing a policy or project to the total benefits generated by it, and determining whether the benefits outweigh the costs. Costs and benefits are adjusted to present day dollars so that projects from different time periods can be compared. A benefit of this approach is that it provides a systematic framework for evaluating the economic feasibility of policies or projects and is relatively simple to conduct. A limitation is that the approach may not fully account for intangible or intangible benefits or costs, such as changes in quality of life or environmental impacts.
- The Vector Error Correction Model: The Vector Error Correction Model (VECM) is a statistical model used in econometrics to analyse the dynamic relationships between multiple time series variables. The VECM approach assumes that economic variables are co-integrated. Co-integration occurs when there is a relationship between 2 or more time-related series. The VECM model estimates short-run behaviour, long-run cointegrating relationship as well as short-run adjustment coefficients. The short-run deviations from long-run equilibrium are corrected and the speed of this correction is shown by the adjustment coefficients. A benefit of the method is that it considers both short-term and long-term relationships of variables. A limitation is that a large dataset is needed to model the long-term relationships accurately.

Source: ACIL Allen 2023; Wynn, 2022, Quantifying the economy-wide returns to innovations for Australia; and European Commission, 2014, The Production Function Methodology for Calculating Potential Growth Rates & Output Gaps.; CSIRO, 2021, Quantifying Australia's returns to innovation; Diewert, E., n.d., The Challenge of Total Factor Productivity Measurement; University of Texas at Dallas, n.d., The Production Function Approach, https://personal.utdallas.edu/~plewin/production.html; SPUR Economics, 2022, Vector Error Correction (VECM) and VAR: Theory; https://spureconomics.com/vector-error-correction-vecm-theory/.

Table B.1 summarises published estimates of ROR to publicly funded R&D. It shows that ROR on publicly funded research vary greatly depending on the methodology used and the subject of the study. On the whole, it may be concluded that R&D ROR in developed economies during the past half century have been strongly positive and may be as high as 75%, although they are more likely to be in the 20% to 50% range.[107]

[107] Department of Industry, Innovation and Science (DIIS) (2016). Op. cit.

Table B.1 Selection of published estimates of the ROR to publicly funded R&D

Author(s)	Subject/industry focus	Methodology/Framework	Annual ROR to public R&D (%)
Agricultural research			
Griliches (1958)	Hybrid corn	Economic surplus approach	21-40
Griliches (1964)	Aggregate agricultural research	Production function approach	35-40
Peterson (1967)	Poultry	Production function approach	21-25
Evenson (1968)	Aggregate agricultural research	Production function approach	28-47
Schmitz and Seckler (1970)	Tomato harvester	Economic surplus approach	16-46
Cline (1975)	Aggregate agricultural research	Production function approach	41-50
Bredahl and Peterson (1976)	Cash Grain Poultry Dairy Livestock	Production function approach	36 37 43 47
Knutson and Tweeten (1979)	Aggregate agricultural research	Production function approach	28-47
Davis (1979)	Aggregate agricultural research	Production function approach	37
Evenson (1979)	Aggregate agricultural research	Production function approach	45
Davis and Peterson (1981)	Aggregate agricultural research	Production function approach	37
Norton (1981)	Poultry Dairy Livestock Cash grain	Production function approach	27-33 56-66 30 44
Scobie and Eveleens (1986)	Aggregate agricultural research	Total factor productivity approach	30
Huffman and Evenson (1993)	Aggregate agricultural research	Production function approach	43-67
Mullen and Cox (1995)	Agricultural research: broadacre (Australia)	Total factor productivity approach	15-40
Frontier Economics (2014)	Aggregate agricultural research (UK)	Production function approach	30-40
Manufacturing/industrial research			
Mansfield (1980)	Industrial R&D	Total factor productivity approach	12
Goodridge et al (2015)	Industrial R&D	Production function approach	20
Frontier Economics (2014)	Aggregate industrial sectors research (UK)	Production function approach	20-28
Mining research			
Productivity Commission (2007)	Longwall mining automation	Cost benefit analysis/IRR	69 [a]
University of South Australia (2018)	Return on AMIRA's P260 Project to the minerals industry	Cost benefit analysis/IRR	110 [b]
Australia Parliament House of Representatives, 2003	CSIRO's robotic mining project	Cost benefit analysis/IRR	720
	Return on 7 minerals and energy R&D projects from CSIRO	Cost benefit analysis/IRR	22.5- 292.5 [c]
ACIL Allen Consulting (2019)	Public R&D in mining geology	Economic surplus approach	1-90
Health/medical research			
Cockburn and Henderson (2000)	Pharmaceuticals	N/A – study presents a literature review	30
OECD (2008)	United States National Institute of Health funded research	N/A – study presents a literature review	15
Sussex et al (2016)	Biomedical and health research in the UK (includes spillover effects)	Econometric vector error correction model (VECM)	15-18

Author(s)	Subject/industry focus	Methodology/Framework	Annual ROR to public R&D (%)
Grant and Buxton (2018)	Musculoskeletal disease research (UK) Cancer research (UK) Cardiovascular disease research (UK)	ROR measured in terms of the additional health gain	10 7-10 9
Grant and Buxton (2018)	Aggregate medical research (UK)	Impact on GDP	15-18
ACIL Allen Consulting (2018)	Public R&D in medical research	Economy-wide approach	12-80
Overall public R&D			
Allen Consulting Group (2003)	Australian Research Council funded research. This considered all 6 ARC research areas at the time, which includes humanities and creative arts.	Total factor productivity approach	25
Productivity Commission (2007)	Public sector agencies. Covers physical, biological, mathematical, and HASS. While the study discusses the impacts of research across these sectors including HASS, no specific estimates for HASS research were provided	Total factor productivity approach	35-100
Hall et. Al (2009)	Various (industry and firm data, sector not specified)	N/A – study presents a literature review	20-30
Salter and Martin (2001) cited in Bornman (2012)	R&D programs in the UK (basic research, does not include research in HASS)	Survey	21-67
European Commission (2017)	Horizon 2020 (European research and innovation Framework Programme). Figure is for 2030. While the study discusses the impacts of research across a wide range of sectors including HASS, no specific estimates for HASS research were provided	Macro-economic modelling approach	30
European Commission (2017)	FP7 (Seventh Framework Programme, European Union R&I funding programme) and Horizon 2020. Does not discuss individual sectors, only public R&I overall.	Case study approach	32
CSIRO (2021)	Average annual return of R&D to Australia (aggregate of public and private funding sources), lower bound is adjusted for additional time and costs associated with integrating R&D into the economy. Upper bound is unadjusted. Does not include HASS research.	Jones and Summers (2020) approach	10-104

Author(s)	Subject/industry focus	Methodology/Framework	Annual ROR to public R&D (%)
Wenjuan and Zhao (2023)	Estimated returns in Gross Regional Product (GRP) per capita for each increase in per capita innovation. Analysis is across 18 different Chinese municipalities over a 10-year period.	Econometric vector error correction model (VECM)	42
Ziesemer (2024)	Internal ROR for public R&D for 17 OECD Countries. The range of internal ROR, excluding outliers, is listed in this table.[d]	Econometric vector error correction model (VECM)/IRR	120-290
Fieldhouse and Mertens (2025)	ROR to non-Defence public R&D investments in the US by research area.	Total factor productivity approach	140-210
Basic (academic science) research in scientific fields [e]			
Mansfield (1991, 1995, 1998)	All academic science research. Based on aggregated figures from scientific fields, including information processing, electrical equipment, chemicals, instruments, drugs, metals, and oil.	Return on investment approach	28
Georghiou (2015)	All academic science research. Based on research on the agriculture and biomedical fields.	Presents a literature review	20-50
Hines (2017)	All academic science research [f]	Presents a literature review	20
Rowell (2023)	All academic science research (UK focus)	Presents a literature review	20-50
Ulrichsen (2024)	Increases to ROI from public investments as a result of the Higher Education Innovation Fund in England.	Return on investment approach	14.8 [g]
Social science research			
Cambridge Econometrics (2012) cited in Rowell (2023)	Social science R&D (UK focus)	Cost benefit analysis/IRR	43 [h]

[a] This ROR has been estimated from a benefit cost ratio (BCR) provided in Table I.9 (automated mining new estimate) of the Productivity Commission's Research Report. As noted in this report, a rough translation of the BCR to the internal ROR is i times the BCR, where i is the discount rate (Alston et al. 2000, cited in Productivity Commission 2007, p. 146).

[b] ROR has been approximated from a BCR of 22:1 and assuming a discount rate of 5%.

[c] ROR has been approximated from BCRs of between 3 and 39 and a discount rate of 7.5%.

[d] Outliers: Austria and Denmark had relatively low IRR (30-45%) due to up to 5 years of losses. Additionally, Finland, Japan and Italy had the highest IRR above 300% behind the infinite values for Canada, France and Ireland. For these 3 countries, positive TFP effects require a policy of first reducing and then increasing public R&D to crowd-in private R&D.

[e] Basic (academic science) research, also called pure research or fundamental research, is a type of scientific research with the aim of improving scientific theories for better understanding and prediction of natural or other phenomena.

[f] This study drew on Mansfield (1991;1998) and Georghiou (2015), in addition to Frontier economics (2014) which focused on agricultural research, Buxton (2009) which focused on biomedical research, Beise and Stahl (1999) which focused on industrial innovation, and European Commission (2017), which focused on technologies and innovation R&I (digital, biotechnologies, energy and the environment, and advanced materials).

[g] This result excludes University of Cambridge spinouts and startups data due to a dramatic increase in external investment secured by active spinouts from the University from 2020-21 onwards. Including the University of Cambridge raises the ROR to 30.2.

[h] ROR has been approximated form a BCR of 1:1.43 (1.43-1 = 0.43 = 43%)

Source: ACIL Allen based on noted sources.

There is some evidence to suggest public R&D has a lower ROR compared to private R&D, both at a private and social level.[108] Gurdgiev and others even report that public R&D contributes virtually nothing to productivity.[109] This analysis can be misleading. Primarily, it does not consider the many spillover benefits associated with public R&D, such as innovation and increasing the capacity for scientific and technological problem-solving[110]. Dagg (2007) concludes that when this is considered, the long-term impact of public R&D may be higher than that of business sector R&D.[111]

An extensive literature review conducted by Frontier Economics (2014) concluded that social returns to R&D (based on spillover benefits from R&D conducted by one agent to the productivity or output of other agents) are typically 2 to 3 times larger than private returns.[112] Further, a US-based study by Lucking, Bloom, and Van Reenen (2018) used 3 decades of firm-level data and a production function–based approach to document evidence of substantial positive net knowledge spillovers of R&D. The authors estimate that social returns are about 60% compared with private returns of around 15%.[113] Sveikauskas (2007) states that spillovers account for roughly three-fifths of the social return to R&D.[114]

It should be noted that Elk et al (2019) found that in their analysis of R&D investments in 22 OECD countries, publicly performed R&D investments did not automatically foster GDP and multi-factor productivity growth in production function models.[115] This study included assumptions on knowledge spillovers between

[108] Hall, B. H., Mairesse, J., & Mohnen, P. (2009). *Measuring the Returns to R&D*. National Bureau of Economic Research Working Paper Series, 15622. Includes references to Griliches, 1980 and 1986; Griliches and Lichtenberg, 1984; Hanel, 1988; Leonard, 1971; Mansfield, 1980; Nadiri and Mamuneas, 1994. Accessed: https://doi.org/10.3386/w15622.

[109] Dagg, M. (2007). *Public investment in R&D in Ireland*. In R. O'Toole & C. Aylward (Eds.), Perspective on Irish productivity, 330–341, Dublin, p. 331. Includes references to Gurdgiev 2006.

[110] Noting that these have been described qualitatively in the main report, see sections 2 and 3.

[111] Dagg, M. (2007). *Public investment in R&D in Ireland*. In R. O'Toole & C. Aylward (Eds.), Perspective on Irish productivity, 330–341, Dublin.

[112] Frontier Economics (2014). *Rates of return to investment in science and innovation*, a report prepared for the Department for Business Innovation and Skills. BIS.

[113] Lucking, B., Bloom, N., & Reenen, V. (2018). Have R&D Spillovers Changed? National Bureau of Economic Research Working Paper Series, No. 24622. https://doi.org/10.3386/w24622. Cited in Bloom, N., Reenen, V., & Williams, H. (2019). A Toolkit of Policies to Promote Innovation. *Journal of Economic Perspectives*, 33(3), 163–184. https://doi.org/10.1257/jep.33.3.163.

[114] Sveikauskas, L. (2007). *R&D and Productivity Growth: A Review of the Literature*. U.S. Bureau of Labor Statistics, Working Papers. No. 408. Cited in OECD. (2015). The Impact of R&D Investment on Economic Performance: A Review of the Econometric Evidence.

[115] Elk, R., Weel. B., Wiel, K.., Wouterse, B. (2019). *Estimating the Returns to Public R&D Investments: Evidence from Production Function Models*, De Economist, 167(1), 45–87.

different countries. The estimates suggest that economic returns to publicly performed R&D appeared to depend on the specific national context. That being said, Table B.1 shows that a range of sectors have experienced significant returns from publicly funded R&D in comparable western nations.

In addition to the studies cited in Table B.1, Gurdgiev's and Elk's findings differ from several other studies investigating the impact of R&D on productivity. A study by Guellec and van Pottelsberge (2001), for example, concluded that a country's public R&D did make a positive contribution to productivity growth (and hence on social ROR) — on average a 1% increase in public R&D resulted in a 0.17% increase in productivity growth.[116] This study assessed the impact of domestic public, domestic business and foreign R&D multifactor productivity growth using a panel of 16 Organisation for Economic Cooperation and Development (OECD) countries from 1980 to 1998.

Studies have also found that the benefits of R&D can accrue to other nations. A widely cited study by Coe and Helpman (1995) examined macroeconomic data from 22 developed economies and found that roughly 25% of R&D spending benefits in G7 economies accrue to trading partners.[117]

However, there has been much debate and criticism on the validity of the historic ROR numbers and on the econometric models used to derive these numbers. Martin (2007) argues that past studies often have major conceptual and methodological problems.[118] Due to the heterogeneity in the relationship between basic research and innovation and commercialisation, the time-lags involved in the realisation of benefits from R&D, as well as the difficulty in quantitatively measuring other supposed spillover benefits, he claims that no simple model of the nature of the economic and social benefits is possible. The Productivity Commission (2007) similarly acknowledges that given a host of unquantifiable economic, social and environmental benefits associated with public R&D, the social ROR on R&D estimates can be unreliable.[119]

The use of such a wide array of analytical techniques, such as general equilibrium models, data linkages and sciento-metric methods, has made comparing different studies difficult. A recent study by the CSIRO on quantifying the economy-wide returns to innovation for Australia provides a summary of several methods for quantifying the returns to innovation. The methods described in this paper include the case study approach, the firm/industry-specific regression approach, the national-level regression approach, the model-driven macroeconomic approach, and the Jones and Summers (2020) approach[120].[121] These approaches, in addition to the other methods described in Box B.1 above, exemplify the broad range of approaches available to measure returns on innovation. To our knowledge, no common framework for developing and using these analytical techniques has been agreed upon.

Although comparisons between public sector research investments are difficult due to methodological inconsistencies, there is still evidence to show that the ROR for publicly funded research is substantial, particularly when compared to other public investments. In a study of economic returns to medical research funding in the UK, Grant and Buxton (2018) noted that the ROR figures for publicly funded medical research were well in excess of the yields of 6-8% that governments typically expect from public investments in aggregate (i.e. it is not specific to value adding investments).[122] This is also in excess of the 3.5% real

[116] Guellec, D. and B. van Pottelsberghe de la Potterie (2001). *R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries*. OECD Science, Technology and Industry Working Papers, No. 2001/03, OECD Publishing, Paris, https://doi.org/10.1787/652870318341.

[117] Coe, D. T., & Helpman, E. (1995). International R&D spillovers. *European Economic Review*, 39(5), 859–887. Cited in Wynn, K., Liu, M., Cohen, J., (2022). Quantifying the economy-wide returns to innovation for Australia, Australian Economics Papers, Wiley, 591-614.

[118] Martin, B. (2007). Op. cit.

[119] Productivity Commission (2007). Op. cit.

[120] The Jones and Summers approach is a macro-level approach that draws on modern innovation-based growth theory to show how average returns to innovation can be calculated by linking the total cost of innovation investments to economy-wide gains in GDP.

[121] Wynn, K., Liu, M., & Cohen, J. (2022). Quantifying the economywide returns to innovation for Australia. Aust Econ Pap, 61(3), 591–614. https://doi.org/https://doi.org/10.1111/14678454.12262

[122] Grant, J., & Buxton, M. J. (2018). Economic returns to medical research funding. BMJ Open, 8(9), e022131. https://doi.org/10.1136/bmjopen2018022131.

annual ROR required by the UK government to make public investments generally.[123] Indeed, most of the ROR figures in Table B.1 are above these thresholds.

Further, the literature review conducted by Frontier Economics (2014) noted that 'There is some evidence that, at least in terms of their impact on private sector productivity, public R&D channelled through the research councils leads to higher social returns than R&D conducted by government departments (civil and defence) or channelled through higher education'.[124]

The latest literature by Ziesemer (2024) and Fieldhouse and Mertens (2025) arrives at higher rates of return to public R&D when compared to previous estimates. Ziesemer (2024) analysed internal ROR to public R&D for 17 OECD countries, consisting of Canada, the UK, the US and other EU countries. Most of these countries had internal ROR above 100%, with the majority falling within the 120-290% range.[125] Similarly, Fieldhouse and Mertens (2025) analysed ROR to public R&D in the US by research area, and established ROR within the 140-210% range.[126]

While Ziesemer (2024) and Fieldhouse and Mertens (2025) established high ROR, analysis by Wenjuan and Zhao (2023)[127] and Ulrichsen (2024), when including the University of Cambridge in the results,[128] aligned with a majority of earlier research that established a ROR between 20% and 50% (see literature review by Rowell (2023)[129]).

Research on Humanities and Social Sciences

In 2012, Cambridge Econometrics used an input-output model to estimate the ROR from R&D investments in the social sciences in the UK. The result was a cost benefit ratio of around 1:1.43.[130] Aside from this analysis, no robust estimates of ROR on research in HASS fields were found in the literature.

- Frontier Economics argues that their research found 'Evidence that (…) all forms of research council spending (including non-scientific spending on social sciences and humanities) yield positive social returns.'[131] However, the report does not provide a suitable reference of the size of these returns.
- The Allen Consulting Group's economic evaluation of the ARC in 2003 noted that 'Research in the humanities could be expected to contribute substantial cultural and social benefits, such as better equipping society to embrace and adapt to change. There could also be significant economic benefits from research in the social sciences - one element of which (the contribution to better policy outcomes in the area of economics) was considered [in the measured economic impacts of the ARC]'.[132] In terms of the measured benefits from better-informed policy, this study found an estimated average of 6% social ROR from ARC funding with an 8-year time lag.

[123] Sussex, J., Feng, Y., MestreFerrandiz, J., Pistollato, M., Hafner, M., Burridge, P., & Grant, J. (2016). Quantifying the economic impact of government and charity funding of medical research on private research and development funding in the United Kingdom. *BMC Medicine*, 14(1), 32. https://doi.org/10.1186/s129160160564z.

[124] Frontier Economics (2014). Op. cit., p. 50.

[125] Ziesemer (2024). Internal rates of return for public R&D from VECM estimates for 17 OECD Countries. Economic Change and Restructuring. 57(164). p. 11. https://doi.org/10.1007/s10644-024-09740-8

[126] Fieldhouse and Mertens (2025). The social returns to public R&D. National Bureau of Economic Research. p 3.

[127] Wenjuan and Zhao (2023). Balancing fiscal expenditure competition and long-term innovation investment: Exploring trade-offs and policy implications for local governments. PLoSONE. 18(11). p. 13. https://doi.org/10.1371/journal.pone.0293158

[128] Ulrichsen (2024). A Quantitative Assessment of the Return on Investment of Research England's Higher Education Innovation Fund (HEIF). p. 38.

[129] Rowell (2023). The economic returns to public investment in social science research: semi-structures literature review. Birkbeck Institutional Research Online. p. 22.

[130] ibid

[131] Frontier Economics (2014). Op. cit., p. 50.

[132] Allen Consulting Group (2003). Op. cit., p. 57.

Finding B.1 ROR on R&D: literature review

Despite differences in methodologies, an overwhelming number of empirical studies indicate that investments in R&D have significant payoffs in terms of productivity, economic growth and living standards. Continued advances in R&D and technology are therefore crucial to ensuring and increasing economic growth.

Generally, studies place the economy-wide social ROR on overall publicly funded research between 20% and 50% a year, while private ROR to R&D investments tend to produce estimates of return of around 30% on average.

B.5 Reference list

ACIL Allen Consulting (2023). *Impact assessment of ARC-funded research*

ACIL Allen Consulting (2019). *Exploring for the Future Program: Return on Investment.*

ACIL Allen Consulting (2018). *Medical technologies and pharmaceuticals sector impact evaluation*

Allen Consulting Group (2003). *A Wealth of Knowledge: The return on investment from ARC-funded research*, report for the Australian Research Council.

Australian Research Council. *NCGP Trends: Success Rates.* Accessed at: https://www.arc.gov.au/ncgp-trends-success-rates

Australian Research Council (2022). *Making a Difference*.

BBC (2026). *Jacinda Ardern's move to Australia renews spotlight on New Zealand's brain drain problem.*

Bredahl, M., Peterson, W. (1976). *The Productivity and Allocation of Research: U.S. Agricultural Experiment Stations.* American Journal of Agricultural Economics, 58(4), 684-692. https://doi.org/10.2307/1238811

Cline, P. L. (1975). *Sources of productivity change in the United States agriculture.* Oklahoma State University.

Cockburn, I. M., Henderson, R. M. et al (2000). *Untangling the origins of competitive advantage.* Strategic Management Journal, 21(10-11), 1123-1145

Coe, D. T., & Helpman, E. (1995). *International R&D spillovers.* European Economic Review, 39(5), 859–887.

CSIRO Futures (2021). *Quantifying Australia's returns to innovation*. CSIRO, Canberra.

Dagg, M. (2007). *Public investment in R&D in Ireland*. In R. O'Toole & C. Aylward (Eds.), *Perspective on Irish productivity*, 330–341, Dublin. Includes references to Gurdgiev, C. (2006).

Davis, J. S. (1979). *A Comparison Of Alternative Procedures For Calculating The Rate Of Return To Agricultural Research Using The Production Function Approach.* University of Minnesota.

Davis, J. S., Peterson, W. L. (1981). *The Declining Productivity of Agricultural Research.* University of Minnesota.

Department of Industry, Innovation and Science (DIIS) (2016). *Australian Innovation System Report 2016*.

Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE) (2012). *2012 National Research Investment Plan.*

Diewert, E., n.d., *The Challenge of Total Factor Productivity Measurement*

Dyakova, M, et al. (2020). *Health Evidence Network Synthesis Report 51*. World Health Organization.

Elk, R., Weel. B., Wiel, K.., Wouterse, B. (2019). *Estimating the Returns to Public R&D Investments: Evidence from Production Function Models*, De Economist, 167(1), 45–87.

European Commission (2014). T*he Production Function Methodology for Calculating Potential Growth Rates & Output Gaps*, Brussels.

European Commission (2017). *The Economic Rationale for Public R&I Funding and its Impact,* Brussels.

European Commission (2017). *Interim evaluation of Horizon 2020.*

European Commission (2021). *Horizon Europe strategic plan 2021-2024*.

European Commission. *Horizon Europe.* Accessed at: https://research-and-innovation.ec.europa.eu/funding/funding-opportunities/funding-programmes-and-open-calls/horizon-europe_en

European Commission (2025). Interim Evaluation of the Horizon Europe Framework Programme for Research and Innovation (2021 – 2024

European Commission (2025) New Econometric Model of Evaluation by Sectoral Interdependency and Supply.

Evenson, R. E. (1968). *The Contribution of Agricultural Research and Extension to Agricultural Production.* University of Illinois.

Evenson, R. E. et al (1979). *Economic benefits from research: an example from agriculture.*

Fieldhouse and Mertens (2025). *The social returns to public R&D. National Bureau of Economic Research*.

Frontier Economics (2014). *Rates of return to investment in science and innovation*, a report prepared for the Department for Business Innovation and Skills. BIS.

Georghiou, L. (2015). *Value of Research,* Policy Paper by the Research, Innovation, and Science Policy Experts (RISE). European Commission.

Goodridge, P et al (2015). *The contribution of public and private R&D to UK productivity growth.* Imperial College, London.

Grant, J., & Buxton, M. J. (2018). *Economic returns to medical research funding*. BMJ Open, 8(9), e022131.

Griliches, Z. (1958). *Research Costs and Social Returns: Hybrid Corn and Related Innovations.* Journal of Political Economy, 66(5), 419-431

Griliches, Z. (1964). *Research Expenditures, Education, and the Aggregate Agricultural Production Function.* The Americal Economic Review, 54(6), 961-974

Guellec, D. and van Pottelsberghe de la Potterie, B. (2001). *R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries*. OECD Science, Technology and Industry Working Papers, No. 2001/03, OECD Publishing, Paris.

Hall, B. H., Mairesse, J., & Mohnen, P. (2009). *Measuring the Returns to R&D*. National Bureau of Economic Research Working Paper Series, 15622. Includes references to Griliches, Z. (1980) and (1986); Griliches, Z. and Lichtenberg, F. (1984); Hanel, P. (1988); Leonard, W. (1971); Mansfield, E. (1980); Nadiri, M. I., and Mamuneas, T. P. (1994).

Hines (2017). *Why fund research? A guide to why EU-funded research and innovation matters*

Huffman, W. E., Evenson, R. E. (1993). *Science for Agriculture.* Iowa State University.

Jones, B. F., Summers, L. H. (2020). *A Calculation of the Social Returns to Innovation.* NBER Working Paper 27863 (2020).

Knutson, M., Tweeten, L. G. (1979). *Toward an Optimal Rate of Growth in Agricultural Production Research and Extension.* American Journal of Agricultural Economics, 61(1), 70-76.

Lucking, B., Bloom, N., & Reenen, V. (2018). *Have R&D Spillovers Changed?* National Bureau of Economic Research Working Paper Series, No. 24622. https://doi.org/10.3386/w24622. Cited in Bloom, N., Reenen, V., & Williams, H. (2019). *A Toolkit of Policies to Promote Innovation*. Journal of Economic Perspectives, 33(3), 163–184.

Mansfield, E. (1980). *Basic Research and Productivity Increase in Manufacturing.* The Americal Economic Review, 70(5), 863-873

Mansfield, E. (1991). *Academic research and industrial innovation.* Research Policy, 20(1), 1-12.

Mansfield, E. (1995). *Academic research and industrial innovation: Sources, Characteristics, and Financing.* The Review of Economics and Statistics, 77(1), 55-65.

Mansfield, E. (1998). *Academic research and industrial innovation: An update of empirical findings.* Research Policy, 26, 773-776.

Martin, B. (2007). *Assessing the Impact of Basic Research on Society and the Economy*.

Meijaard, E., Brooks, T. M., Carlson, K. M., Slade, E. M., Garcia-Ulloa, J., Gaveau, D. L., ... & Sheil, D. (2020). The environmental impacts of palm oil in context. *Nature plants*, *6*(12), 1418-1426.

Ministry of Business, Innovation and Employment (2024). Endeavour Fund Investment Plan 2025-2027: Transforming New Zealand's future.

Ministry of Research, Science and Technology (2007). *Vision Mātauranga Unlocking the Innovation Potential of Māori Knowledge, Resources and People*.

Ministry of Business, Innovation and Employment (2026). *A new funding strategy for the science system*.

Mullen, J. D., Cox, T. L. (1995). *The returns from research in Australian broadacre agriculture.* Australian Journal of Agricultural Economics, 39(2), 105-128.

National Health and Medical Research Council (NHMRC) (2010). *NHMRC Strategic Plan 2010-2012*

New Zealand Government (2015). *National Statement of Science Investment 2015–2025*. New Zealand Government.

Norton, G. W., Davis, J. S. (1981). *Evaluating Returns to Agricultural Research: A Review.* Americal Journal of Agricultural Economics 63(4), 685-699.

OECD (2008). *OECD Science, Technology and Industry Outlook.*

Padial-Jaudenes, M., Castanys-Munoz, E., Ramirez, M., & Lasekan, J. (2020). Physiological impact of palm olein or palm oil in infant formulas: a review of clinical evidence. *Nutrients*, *12*(12), 3676.

The Parliament of the Commonwealth of Australia (2003). *Riding the Innovation Wave: The Case for Increasing Business Investment in R&D.*

Peterson, W. L. (1967). *Return to Poultry Research in the United States.* American Journal of Agricultural Economics 49(3), 656-669.

Petrescu, M. (2025). New Zealand's Productivity Challenge: New Zealand. Selected Issues Papers, 2025(075), Article A001, A001

Productivity Commission (2007). *Public Support for Science and Innovation*. SSRN Electronic Journal.

Rowell (2023). The economic returns to public investment in social science research: semi-structures literature review. Birkbeck Institutional Research Online.

Salter, A. J., & Martin, B. R. (2001). *The economic benefits of publicly funded basic research: a critical review.* Research Policy, 30(3), 509–532.

Schmitz, A., Seckler, D. (1970). *Mechanized Agriculture and Social Welfare: The Case of the Tomato Harvester.* Americal Journal of Agricultural Economics, 52(4), 569-577

Scobie, G., Eveleens, W. M. (1986). *Agricultural research: What's it worth?* In Ruakura Farmers Conference, Hamilton

SPUR Economics (2022) *Vector Error Correction (VECM) and VAR: Theory*; https://spureconomics.com/vector-error-correction-vecm-theory/.

Sussex, J., Feng, Y., MestreFerrandiz, J., Pistollato, M., Hafner, M., Burridge, P., & Grant, J. (2016). *Quantifying the economic impact of government and charity funding of medical research on private research and development funding in the United Kingdom*. BMC Medicine, 14(1), 32.

Sveikauskas, L. (2007). R*&D and Productivity Growth: A Review of the Literature*. U.S. Bureau of Labor Statistics, Working Papers. No. 408. Cited in OECD. (2015). *The Impact of R&D Investment on Economic Performance: A Review of the Econometric Evidence.*

UKRI (2023). *SPF Interim Impact Evaluation – Main Report.*

UKRI (2024) *Strategic Priorities Fund.*

UKRI (2025). UKRI investment and outputs data 2015 to 2025.

Ulrichsen, T. C. (2024). *A Quantitative Assessment of the Return on Investment of Research England's Higher Education Innovation Fund (HEIF)*

University of South Australia (2018). *Engagement and Impact 2018- Third year sustained impact for mineral processing – AMIRA P260 Flotation.*

University of Texas at Dallas, n.d., *The Production Function Approach*, https://personal.utdallas.edu/~plewin/production.html

Wenjuan, S., and Zhao, K. (2023). *Balancing fiscal expenditure competition and long-term innovation investment: Exploring trade-offs and policy implications for local governments*. PLoSONE. 18(11)

Wynn, K., Liu, M., Cohen, J., (2022). *Quantifying the economy-wide returns to innovation for Australia*, Australian Economics Papers, Wiley, 591-614.

Ziesemer, T. H. W (2024). *Internal rates of return for public R&D from VECM estimates for 17 OECD Countries. Economic Change and Restructuring*. 57(164).

C The *Tasman Global* model

Tasman Global is a dynamic, global Computable General Equilibrium (CGE) model that has been developed by ACIL Allen for the purpose of undertaking economic impact analysis at the regional, state, national and global levels.

A CGE model captures the complex interrelationships between the markets of all commodities and factors, while also considering resource constraints, to find a simultaneous equilibrium in all markets. A global CGE model extends this interdependence of the markets across world regions and finds simultaneous equilibrium globally. A dynamic model adds onto this the interconnection of equilibrium economies across time periods. For example, investments made today are going to determine the capital stocks of tomorrow and hence future equilibrium outcomes depend on today's equilibrium outcome, and so on.

A dynamic global CGE model, such as *Tasman Global*, has the capability of addressing total, sectoral, spatial and temporal efficiency of resource allocation as it connects markets globally and over time. Being a recursively dynamic model, however, its ability to address temporal issues is limited. In particular, *Tasman Global* cannot typically address issues requiring partial or perfect foresight. However, as documented in Jakeman et al (2001), it is possible to introduce partial or perfect foresight in certain markets using algorithmic approaches.[133] Notwithstanding this, the model does have the capability to project the economic impacts over time of given changes in policies, tastes and technologies in any region of the world economy on all sectors and agents of all regions of the world economy.

Tasman Global was developed from the 2001 version of the Global Trade and Environment Model (GTEM) developed by ABARE (Pant 2007)[134] and has undergone continuous development since. GTEM itself was developed out of the MEGABARE model,[135] which contained significant advancements over the Global Trade Analysis Project (GTAP) model of that time.[136] This lineage reflects a long history of advancement in global CGE modelling frameworks.

C.1 A dynamic model

Tasman Global is a model that estimates relationships between variables at different points in time. This contrasts with comparative static models, which compare 2 equilibriums (one before an economic disturbance and one following). A dynamic model such as *Tasman Global* is beneficial when analysing issues for which both the timing of and the adjustment path that economies follow are relevant in the analysis.

C.2 The database

A key advantage of *Tasman Global* is the level of detail in the database underpinning the model. The database is derived from the GTAP database.[137] This database is a fully documented, publicly available

[133] Jakeman, G., Heyhoe, E., Pant, H., Woffenden, K. and Fisher, B.S. (2001). *The Kyoto Protocol: economic impacts under the terms of the Bonn agreement*. ABARE paper presented to the International Petroleum Industry Environmental Conservation Association conference, 'Long Term Carbon and Energy Management - Issues and Approaches', Cambridge, Massachusetts, 15-16 October.

[134] Pant, H.M. (2007), *GTEM: Global Trade and Environment Model*, ABARE Technical Report, Canberra.

[135] Hanslow, K. & Hinchy, M. (1996). *The MEGABARE model: interim documentation*. Canberra: ABARE.

[136] Hertel, T. (1997). *Global Trade Analysis: modelling and applications*. Cambridge University Press, Cambridge.

[137] Aguiar, A., Chepeliev, M., Corong, E., McDougall, R., & van der Mensbrugghe, D. (2019). *The GTAP Data Base: Version 10.* Journal of Global Economic Analysis, 4(1), 1-27.

global data base which contains complete bilateral trade information, transport and protection linkages among regions for all GTAP commodities. It is the most detailed database of its type in the world.

Tasman Global builds on the GTAP database by adding the following important features:

— a detailed population and labour market database

— detailed technology representation within key industries (such as electricity generation and iron and steel production)

— disaggregation of a range of major commodities including iron ore, bauxite, alumina, primary aluminium, brown coal, black coal and LNG

— the ability to repatriate labour and capital income.

Nominally, version 10.1 of the *Tasman Global* database divides the world economy into 153 regions (145 international regions plus the 8 states and territories of Australia) although the regions are frequently disaggregated further. ACIL Allen regularly models Australian or international projects or policies at the regional level including at the or at the state/territory/provincial level for various countries.

The *Tasman Global* database also contains a wealth of sectoral detail currently identifying up to 76 industries (Table C.1). The foundation of this information is the input-output tables that underpin the database. The input-output tables account for the distribution of industry production to satisfy industry and final demands.

Industry demands, so-called intermediate usage, are the demands from each industry for inputs. For example, electricity is an input into the production of communications. In other words, the communications industry uses electricity as an intermediate input.

Final demands are those made by households, governments, investors and foreigners (export demand). These final demands, as the name suggests, represent the demand for finished goods and services. To continue the example, electricity is used by households – their consumption of electricity is a final demand.

Each sector in the economy is typically assumed to produce one commodity, although in *Tasman Global*, the electricity, transport and iron and steel sectors are modelled using a 'technology bundle' approach. With this approach, different known production methods are used to generate a homogeneous output for the 'technology bundle' industry. For example, electricity can be generated using brown coal, black coal, petroleum, base load gas, peak load gas, nuclear, hydro, geothermal, biomass, wind, solar or other renewable based technologies – each of which has its own cost structure.

The other key feature of the database is that the cost structure of each industry is also represented in detail. Each industry purchases intermediate inputs (from domestic and imported sources) primary factors (labour, capital, land and natural resources) as well as paying taxes or receiving subsidies.

Table C.1 Standard sectors in the Tasman Global CGE model

no	Name	no	Name
1	Paddy rice	39	Diesel (incl. nonconventional diesel)
2	Wheat	40	Other petroleum, coal products
3	Cereal grains nec	41	Chemical, rubber, plastic products
4	Vegetables, fruit, nuts	42	Iron ore
5	Oil seeds	43	Bauxite
6	Sugar cane, sugar beet	44	Mineral products nec
7	Plant- based fibres	45	Ferrous metals
8	Crops nec	46	Alumina
9	Bovine cattle, sheep, goats, horses	47	Primary aluminium
10	Pigs	48	Metals nec

no	Name	no	Name
11	Animal products nec	49	Metal products
12	Raw milk	50	Motor vehicle and parts
13	Wool, silkworm cocoons	51	Transport equipment nec
14	Forestry	52	Electronic equipment
15	Fishing	53	Machinery and equipment nec
16	Brown coal	54	Manufactures nec
17	Black coal	55	Electricity generation
18	Oil	56	Electricity transmission and distribution
19	LNG	57	Gas manufacture, distribution
20	Other natural gas	58	Water
21	Minerals nec	59	Construction
22	Bovine meat products	60	Trade
23	Pig meat products	61	Road transport
24	Meat products nec	62	Rail and pipeline transport
25	Vegetables oils and fats	63	Water transport
26	Dairy products	64	Air transport
27	Processed rice	65	Transport nec
28	Sugar	66	Warehousing and support activities
29	Food products nec	67	
30	Wine	68	Communication
31	Beer	69	Financial services nec
32	Spirits and RTDs	70	Insurance
33	Other beverages and tobacco products	71	Business services nec
34	Textiles	72	Recreational and other services
35	Wearing apparel	73	Public Administration and Defence
36	Leather products	74	Education
37	Wood products	75	Human health and social work activities
38	Paper products, publishing	76	Dwellings

Source: ACIL Allen.

Note: nec = not elsewhere classified.

C.3 Model structure

Given its heritage, the structure of the *Tasman Global* model closely follows that of the GTAP and GTEM models and interested readers are encouraged to refer to the documentation of these models for more detail.[138] In summary:

- The model divides the world into a variety of regions and international waters.
  - Each region is fully represented with its own 'bottom-up' social accounting matrix and could be a local community, an LGA, state, country or a group of countries. The number of regions in a given simulation depends on the database aggregation. Each region consists of households, a government with a tax system, production sectors, investors, traders and finance brokers.

[138] Namely Hertel, T. (1997). Op. cit. and Pant, H.M. (2007). Op. cit., respectively.

  - 'International waters' are a hypothetical region in which global traders operate and use international shipping services to ship goods from one region to the other. It also houses an international finance 'clearing house' that pools global savings and allocates the fund to investors located in every region.
  - Each region has a 'regional household'[139] that collects all factor payments, taxes, net foreign borrowings, net repatriation of factor incomes due to foreign ownership and any net income from trading of emission permits.
- The income of the regional household is allocated across private consumption, government consumption and savings according to a Cobb-Douglas utility function, which, in practice, means that the share of income going to each component is assumed to remain constant in nominal terms.
- Private consumption of each commodity is determined by maximising utility subject to a Constant Difference of Elasticities (CDE) function which includes both price and income elasticities.
- Government consumption of each commodity is determined by maximising utility subject to a Cobb-Douglas utility function.
- Each region has *n* production sectors, each producing single products using various production functions where they aim to maximise profits (or minimise costs) and take all prices as given. The nature of the production functions chosen in the model means that producers exhibit constant returns to scale.
  - In general, each producer supplies consumption goods by combining an aggregate energy-primary factor bundle with other intermediate inputs and according to a Leontief production function (which in practice means that the quantity shares remain in fixed proportions). Within the aggregate energy-primary factor bundle, the individual energy commodities and primary factors are combined using a nested Constant Elasticity of Substitution (CES) production function, in which energy and primary factor aggregates substitute according to a CES function with the individual energy commodities and individual primary factors substituting with their respective aggregates according to further CES production functions.
  - Exceptions to the above include the electricity generation, iron and steel and road transport sectors. These sectors employ the 'technology bundle' approach developed by ABARE[140] in which non-homogenous technologies are employed to produce a homogenous output with the choice of technology governed by minimising costs according to a modified Constant Ratios of Elasticities of Substitution, Homothetic (CRESH) production function. For example, electricity may be generated from a variety of technologies (including brown coal, black coal, gas, nuclear, hydro, solar etc.), iron and steel may be produced from blast furnace or electric arc technologies while road transport services may be supplied using a range of different vehicle technologies. The 'modified-CRESH' function differs from the traditional CRESH function by also imposing the condition that the quantity units are homogenous.
- There are 4 types of primary factors (land, labour, mobile capital and fixed capital). While labour and mobile capital are used by all production sectors, land is only used by agricultural sectors while fixed capital is typically employed in industries with natural resources (such as fishing, forestry and mining) or in selected industries built by ACIL Allen.
  - Land supply in each region is typically assumed to remain fixed through time with the allocation of land between sectors occurring to maximise returns subject to a Constant Elasticity of Transformation (CET) utility function.
  - Mobile capital accumulates as a result of net investment. It is implicitly assumed in *Tasman Global* that it takes one year for capital to be installed. Hence, supply of capital in the current period depends on the last year's capital stock and investments made during the previous year.

[139] The term "regional household" was devised for the GTAP model. In essence it is an agent that aggregates all incomes attributable to the residents of a given region before distributing the funds to the various types of regional consumption (including savings).

[140] Hanslow, K. & Hinchy, M. (1996). Op. cit.

- Labour supply in each year is determined by endogenous changes in population, given participation rates and a given unemployment rate. In policy scenarios, the supply of labour is positively influenced by movements in the real wage rate governed by the elasticity of supply. For countries where sub-regions have been specified (such as Australia), migration between regions is induced by changes in relative real wages with the constraint that net interregional migration equals zero. For regions where the labour market has been disaggregated to include skills or occupations, there is limited substitution allowed between the skills or occupations by individuals supplying labour (according to a CET utility function) and by firms demanding labour (according to a CES production function) based on movements in relative real wages.
- The supply of fixed capital is given for each sector in each region.

The model has the option for these assumptions to be changed at the time of model application if alternative factor supply behaviours are considered more relevant.

- It is assumed that labour (by occupation) and mobile capital are fully mobile across production sectors implying that, in equilibrium, wage rates (by occupation) and rental rates on capital are equalised across all sectors within each region. To a lesser extent, labour and capital are mobile between regions through international financial investment and migration, but this sort of mobility is sluggish and does not equalise rates of return across regions.
- For most international regions, for each consumer (private, government, industries and the local investment sector), consumption goods can be sourced either from domestic or imported sources. In any country that has disaggregated regions (such as Australia), consumption goods can also be sourced from other intrastate or interstate regions. In all cases, the source of non-domestically produced consumption goods is determined by minimising costs subject to a CRESH utility function. Like most other CGE models, a CES demand function is used to model the relative demand for domestically produced commodities versus non-domestically produced commodities. The elasticities chosen for the CES and CRESH demand functions mean that consumers in each region have a higher preference for domestically produced commodities than non-domestic commodities and a higher preference for intrastate- or interstate-produced commodities than foreign commodities.
- The capital account in *Tasman Global* is open. Domestic savers in each region purchase 'bonds' in the global financial market through local 'brokers' while investors in each region sell bonds to the global financial market to raise investible funds. A flexible global interest rate clears the global financial market.
- It is assumed that regions may differ in their risk characteristics and policy configurations. As a result, rates of return on money invested in physical capital may differ between regions and therefore may be different from the global cost of funds. Any difference between the local rates of return on capital and the global cost of borrowing is treated as the result of the existence of a risk premium and policy imperfections in the international capital market. It is maintained that the equilibrium allocation of investment requires the equalisation of changes in (as opposed to the absolute levels of) rates of return over the base year rates of return.
- Any excess of investment over domestic savings in a given region causes an increase in the net debt of that region. It is assumed that debtors service the debt at the interest rate that clears the global financial market. Similarly, regions that are net savers gives rise to interest receipts from the global financial market at the same interest rate.
- Investment in each region is used by the regional investor to purchase a suite of intermediate goods according to a Leontief production function to construct capital stock with the regional investor cost minimising by choosing between domestic, interstate and imported sources of each intermediate good via the CRESH production function. The regional cost of creating new capital stock versus the local rates of return on mobile capital is what determines the regional rate of return on new investment.
- In equilibrium, exports of a good from one region to the rest of world are equal to the import demand for that good in the remaining regions. Together with the merchandise trade balance, the net payments on

foreign debt add up to the current account balance. *Tasman Global* does not require that the current account be in balance every year. It allows the capital account to move in a compensatory direction to maintain the balance of payments. The exchange rate provides the flexibility to keep the balance of payments in balance.

— Detailed bilateral transport margins for every commodity are specified in the starting database. By default, the bilateral transport mode shares are assumed to be constant, with the supply of international transportation services by each region solved by a cost-minimising international trader according to a Cobb-Douglas demand function.

— Emissions of 6 anthropogenic greenhouse gases (namely, carbon dioxide, methane, nitrous oxide, HFCs, PFCs and SF_6) associated with economic activity are tracked in the model. Almost all sources and sectors are represented; emissions from agricultural residues and land-use change and forestry activities are not explicitly modelled but can be accounted for externally. Prices can be applied to emissions which are converted to industry-specific production taxes or commodity-specific sales taxes that impact on demand. Abatement technologies similar to those adopted in a report released by the Commonwealth Government (2008) are available and emission quotas can be set globally or by region along with allocation schemes that enable emissions to be traded between regions.[141]

More detail regarding specific elements of the model structure is discussed in the following sections.

C.4 Population growth and labour supply

Population growth is an important determinant of economic growth through the supply of labour and the demand for final goods and services. Population growth for each region represented in the *Tasman Global* database is projected using ACIL Allen's in-house demographic model. The demographic model projects how the population in each region grows and how age and gender composition changes over time and is an important tool for determining the changes in regional labour supply and total population over the projected period.

For each of region, the model projects the changes in age-specific birth, mortality and net migration rates by gender for 101 age cohorts (0-99 and 100+). The demographic model also projects changes in participation rates by gender by age for each region, and, when combined with the age and gender composition of the population, endogenously projects the future supply of labour in each region. Changes in life expectancy are a function of income per person as well as assumed technical progress on lowering mortality rates for a given income (for example, reducing malaria-related mortality through better medicines, education, governance etc.). Participation rates are a function of life expectancy as well as expected changes in higher education rates, fertility rates and changes in the work force as a share of the total population.

Labour supply is derived from the combination of the projected regional population by age by gender and regional participation rates by age by gender. Over the projected period labour supply in most developed economies is projected to grow slower than total population because of ageing population effects.

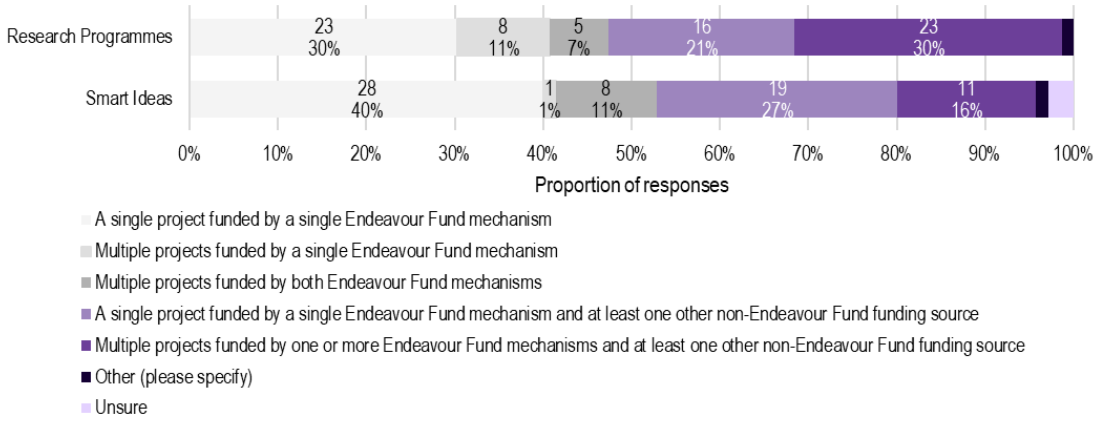
[141] Australian Government (2008), *Australia's Low Pollution Future: the economics of climate change mitigation*, Australian Government, Canberra.

D Additional Survey Results

D.1 Attribution

Around half of respondents had projects that were solely funded by one or both Endeavour Fund mechanisms. In comparison to Smart Ideas, a greater proportion of Research Programmes were funded by at least one non-Endeavour Fund funding source (see Figure D.1).

Figure D.1 Funding sources

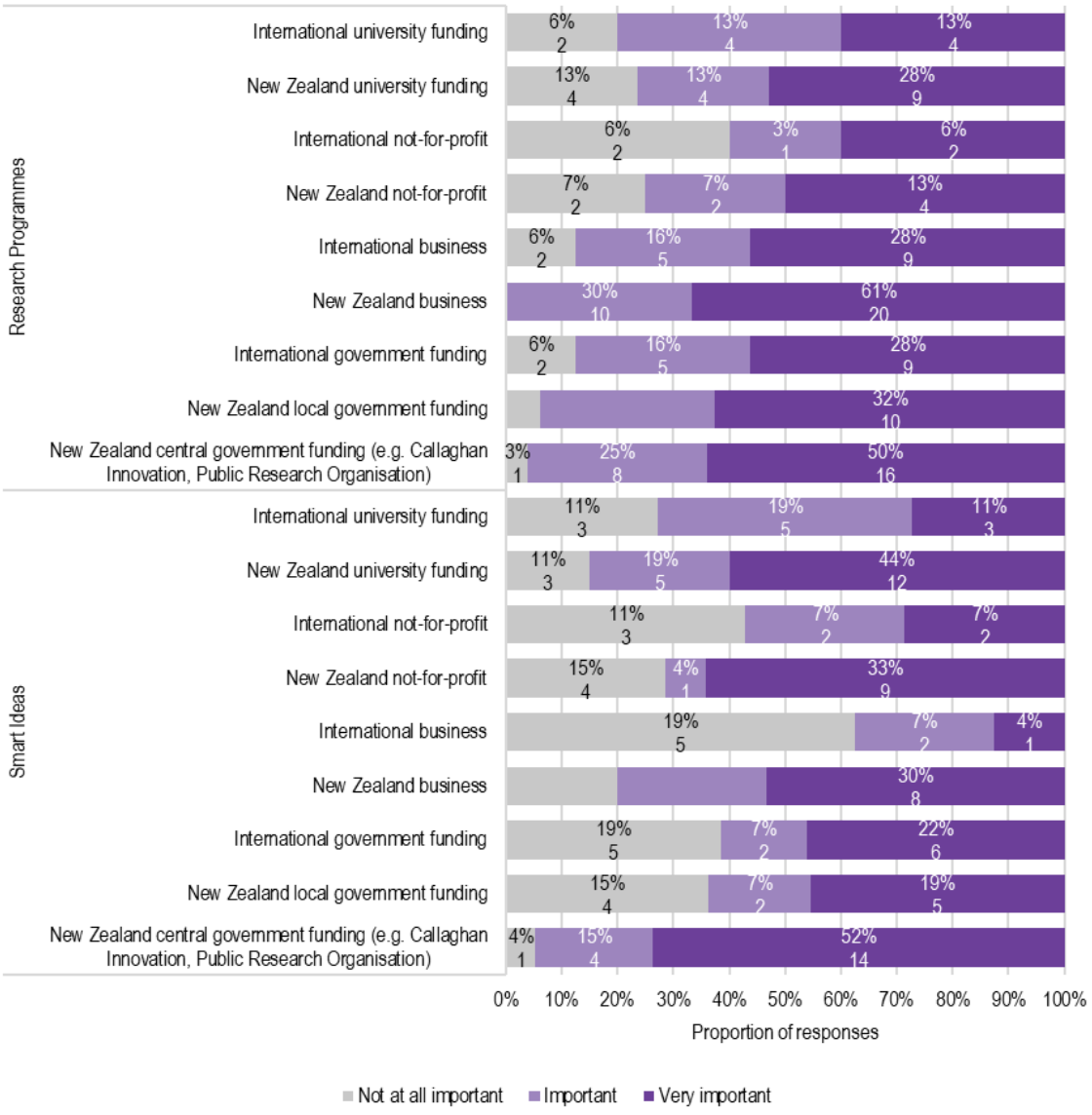


Note: 128 total respondents (70 Smart Ideas, 76 Research Programmes, 18 across both).

Source: ACIL Allen

Respondents indicated that other funding sources were not applicable in most circumstances. Circumstances where funding from other sources was important (or very important) included New Zealand central government and university funding for Smart Ideas, and New Zealand central government and business funding for Research Programmes.

Figure D.2 How critical funding received was in gaining funding from other sources

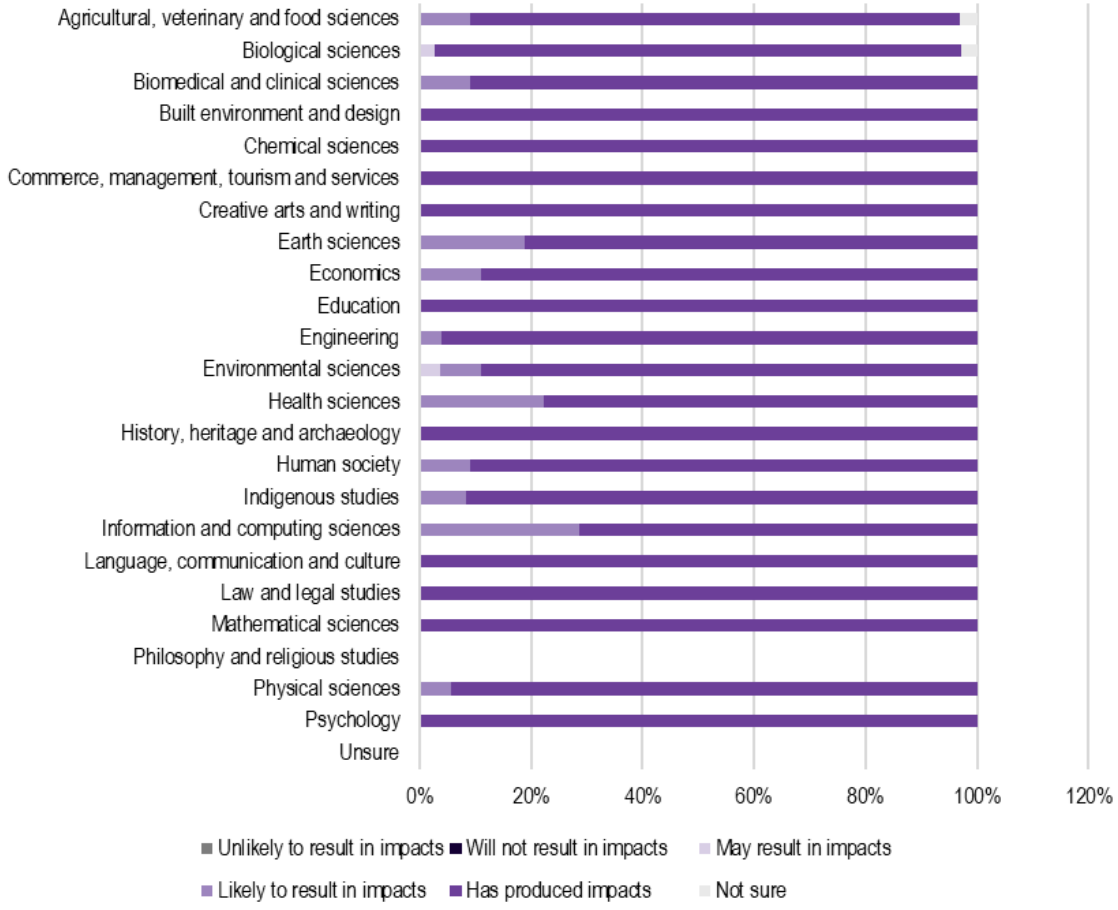


Note: 27 Smart Ideas respondents and 34 Research Programmes respondents indicated funding was critical to gaining funding from other sources. All Smart Ideas respondents replied to all questions, between 30 and 33 Research Programmes respondents replied to questions.

Source: ACIL Allen

D.2 Impact by field of research

Figure D.3 Academic impacts by field of research

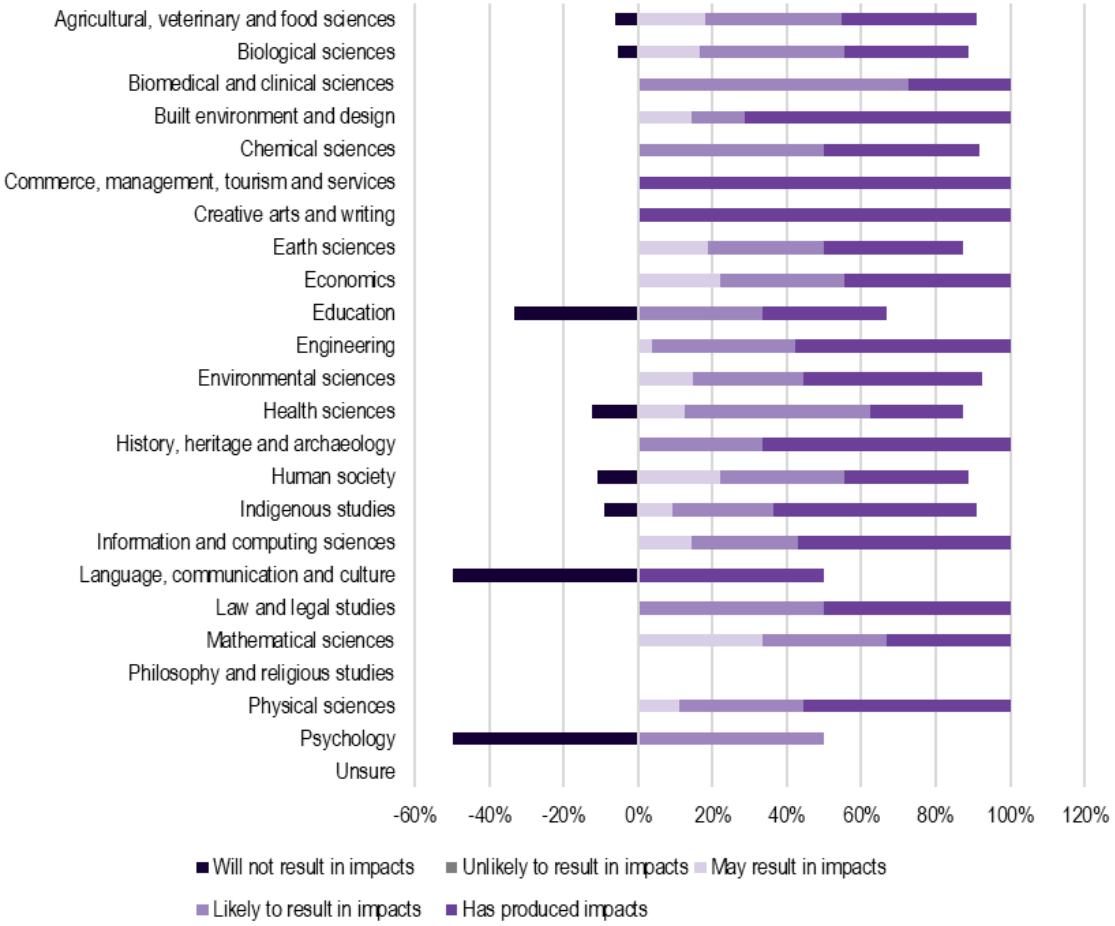


Note: 131 total respondents to the survey. 76 respondents indicated which field(s) their research was in. Of these respondents, 64 indicated their research was across multiple fields.

Source: ACIL Allen

At least a third of respondents with projects in Education, Language, communication and culture, and Psychology indicated their research would not/was unlikely to result in economic impacts (Figure D.4).

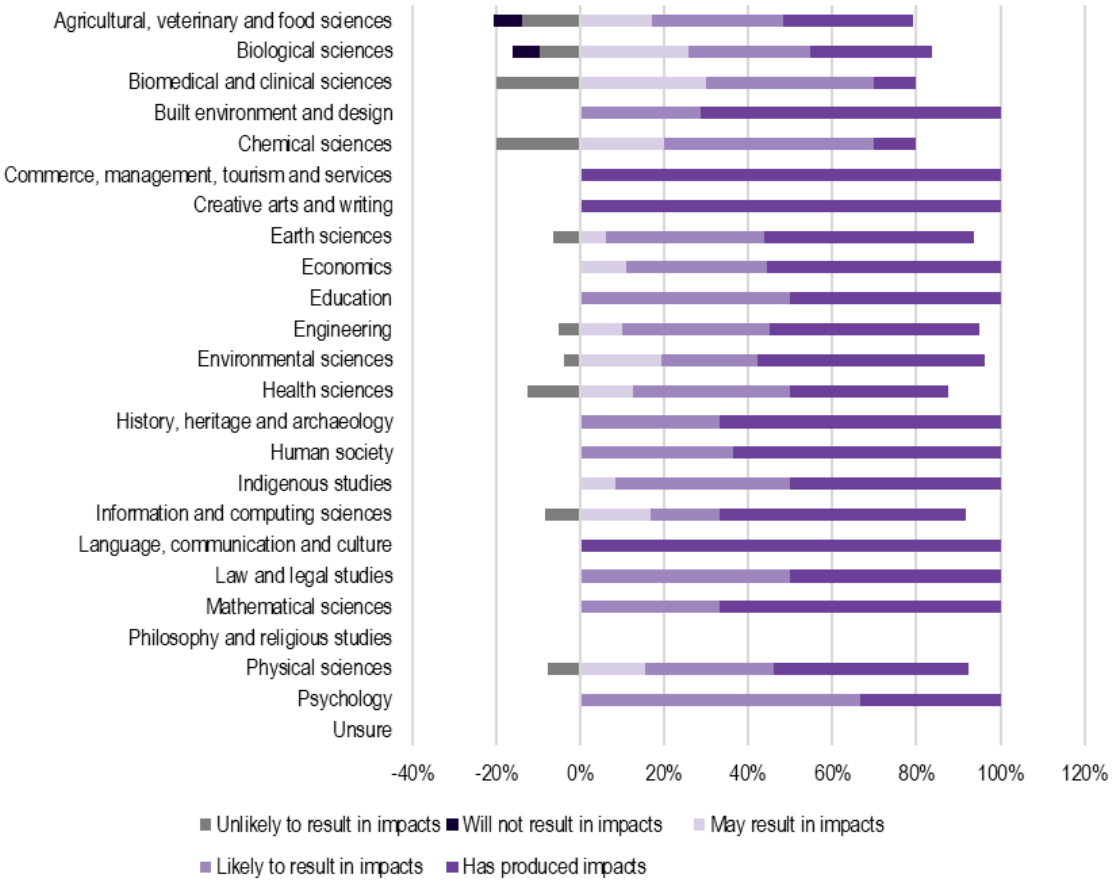
Figure D.4 Economic impacts by field of research



Note: 131 total respondents to the survey. 76 respondents indicated which field(s) their research was in. Of these respondents, 64 indicated their research was across multiple fields.

Source: ACIL Allen

Figure D.5 Social impacts by field of research

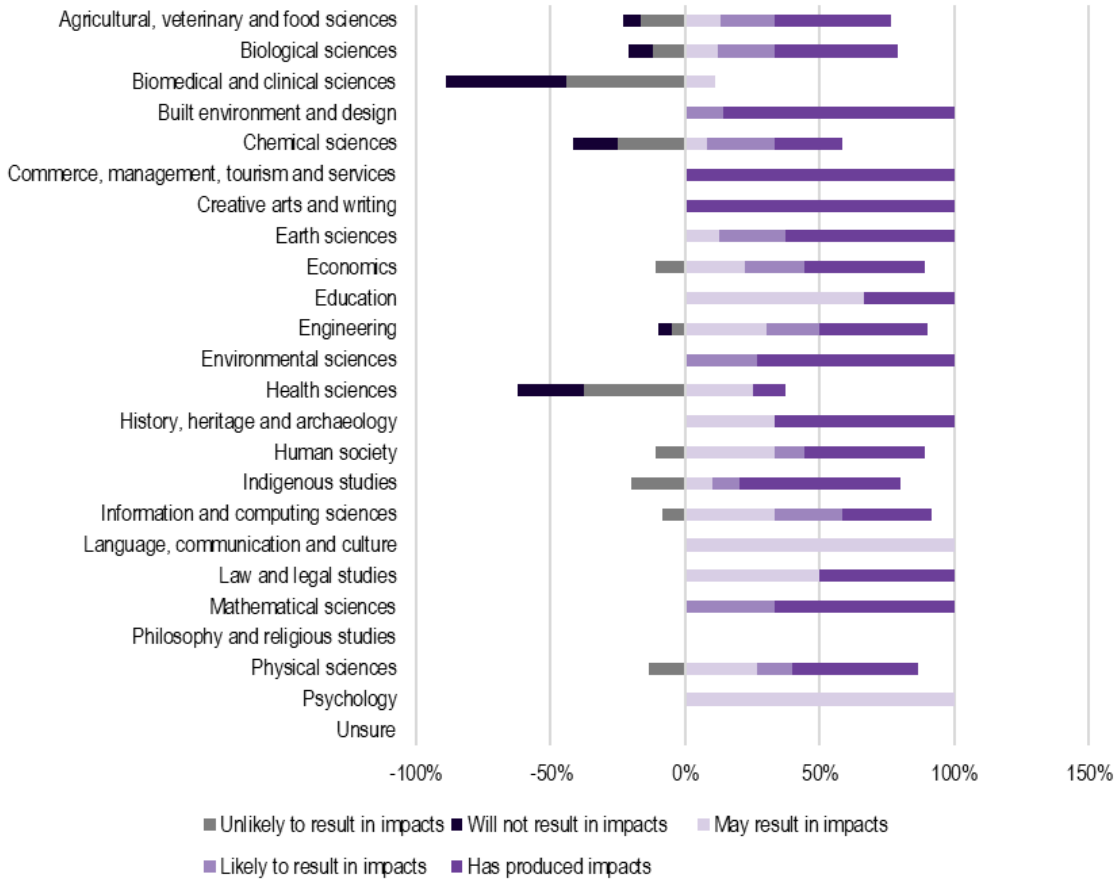


Note: 131 total respondents to the survey. 76 respondents indicated which field(s) their research was in. Of these respondents, 64 indicated their research was across multiple fields.

Source: ACIL Allen

At least a third of respondents in Biomedical and clinical sciences, Chemical sciences, and Health sciences indicated their research would not/was unlikely to result in environmental impacts (see Figure D.6).

Figure D.6 Environmental impacts by field of research

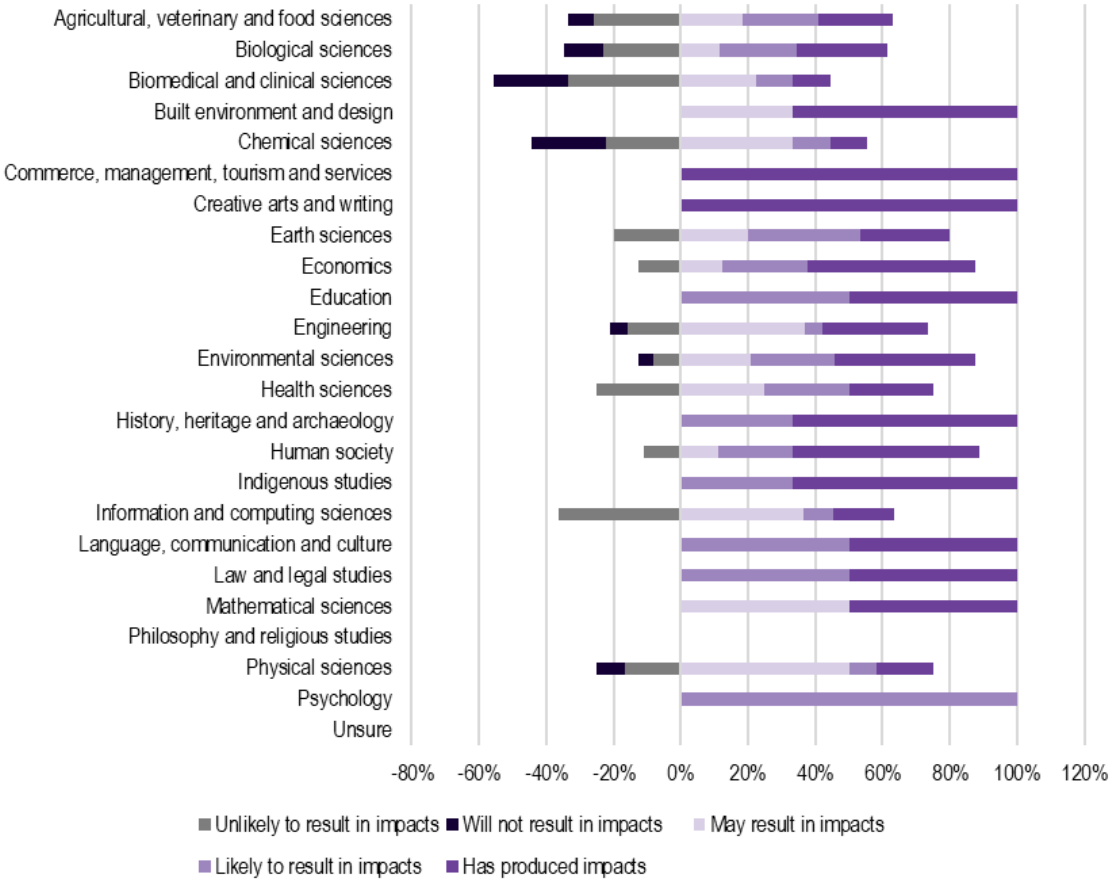


Note: 131 total respondents to the survey. 76 respondents indicated which field(s) their research was in. Of these respondents, 64 indicated their research was across multiple fields.

Source: ACIL Allen

At least a third of respondents in Agricultural, veterinary and food sciences, Biological sciences, Biomedical and clinical sciences, Chemical sciences, and Information and Computing Sciences indicated their research would not/was unlikely to result in cultural impacts (see Figure D.7).

Figure D.7 Cultural impacts by field of research



Note: 131 total respondents to the survey. 76 respondents indicated which field(s) their research was in. Of these respondents, 64 indicated their research was across multiple fields.

Source: ACIL Allen

Melbourne
Suite 4, Level 19, North Tower
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Brisbane
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Canberra
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Canberra ACT 2601 Australia
+61 2 6103 8200

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